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Volume I
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STRESS HISTORY SIMULATION

Volume I
A USER'S MANUAL FOR A COMPUTER PROGRAM TO GENERATE STRESS HISTORY SIMULATIONS

MCDONNELL DOUGLAS CORPORATION
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AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report presents a description of a computer program to generate stress histories using random noise theory. A Gaussian random time history is generated and searched to detect peaks and valleys. The Gaussian peak and valley history is transformed to simulate real time history. The resulting list of peaks and valleys is filtered, using input rise and fall criteria, in order to eliminate stress excursions that the user does not wish to consider. Volume II of this report describes a computer program that uses as input lists

of filtered peaks and valleys, generated by this program, and performs operations to combine and create variations of the input lists. Both of the computer programs were used in a study of load sequence effects on crack growth, summarized in AFFDL-TR-76-112, "Effects of Fighter Attack Spectrum on Crack Growth".

FOREWORD

This report was prepared by McDonnell Aircraft Company (MCAIR), St. Louis, Missouri, for the Structural Integrity Branch, Structural Mechanics Division, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio under Contract F33615-75-C-3112, Project 486U "Advanced Metallic Structures", Work Unit 486U0213, "Effect of Fighter Attack Spectrum on Crack Growth". The contract was administered by Mr. John M. Potter, Project Engineer, AFFDL/FBE.

The computer program that was developed and used during this study was accomplished by the Strength Department of McDonnell Aircraft Company (MCAIR). The study manager for MCAIR was J. F. Schier. Principal authors of this report are H. D. Dill and H. T. Young. L. F. Impellizzeri and F. R. Foster contributed to spectra development in the study, and C. R. Wilson assisted in computer program development.

This report covers work accomplished during the time period May 1975 through July 1976.

This report was released by the authors in August 1976 for publication.

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SYMBOLS

A_K	Coefficient defined by Equations (3) and (4)
B_K	Random phase angle, $0 \leq B_K \leq 2\pi$
C1, C2, C3	Coefficients in the equation $x = C1 + C2\ t + C3\ t^2$, used to search for a peak or valley value
D_K	Harmonic coefficient, see Figure 1
IFSET	HARM subroutine control, IFSET = 1 sets up sine and inverse tables and calculates Fourier transform
J	Integer representing time in HARM subroutine
M	Mean value used in mapping Gaussian to simulated real time history
M1	$N = 2^{M1}$, see N
N	Number of points to be computed in the random time history
NØPTS	The number of points in the linear interpolation of subroutine TLU
NR	Factor by which the PSD frequency axis is extended to increase the sensitivity of the output
NSPD	Number of input data points on the PSD vs frequency graph
NX	Number of divisions of the PSD graph used in analysis
N_o	Theoretical number of mean level crossings per unit time
N_p	Theoretical number of peaks per unit time
$N_{Total,x}$	Theoretical number of Gaussian peaks exceeding the value x in the total time represented by the Gaussian time history
$N_{Total,y}$	Theoretical number of simulated real peaks exceeding the value y in the total time represented by the Gaussian time history
N_x	Theoretical number of Gaussian peaks exceeding the value x per unit time
N_y	Theoretical number of simulated real peaks exceeding the value y per unit time
P(x)	Probability of not exceeding x, normal probability distribution
PMAX, PMIN	In order for a peak and valley to be counted and included in the output list, the maximum rise or fall must exceed the input value of PMAX, and the minimum rise and fall must exceed the input value of PMIN

PSD	Power Spectral Density
R	Transformation exponent used in mapping Gaussian to simulated real time history
SL1	Difference in value of two consecutive Gaussian time history points, i, i + 1
SL2	Difference in value of next two consecutive points, i + 1, i + 2, see SL1
S	Power spectral density
t	Time
X	An independent value, also a Gaussian history value
XVAL	Independent variable to ue used in interpolation in a two-dimensional table
y	A dependent value, also a simulated real time history value
YVAL	Dependent variable determined by interpolation of a two-dimensional table.
σ	Standard deviation
ω	Frequency
ω_u	Upper limit of frequency of input power spectral density

1. SUMMARY

Load factor time histories developed using random noise simulation have been shown to correlate well with measured flight load factor histories. This makes random noise theory attractive for generation of fatigue test spectra. A common fault of other methods of load factor history simulation is arbitrary, unrealistic, coupling of peaks and valleys. The random noise theory approach requires that the random load factor time history be generated possessing a specified power spectral density (PSD) shape, and mean and RMS level. An advantage of the random noise theory approach is that both the exceedance content and the frequency content of the process can be preserved. The preservation of the frequency content assures that proper coupling of peaks and valleys is attained.

Volume II of this report, Reference 1, describes a computer program that uses as input lists of filtered peaks and valleys generated by this program, and performs operations to combine and create variations of the input lists. Both of these computer programs were used in a study of load sequence effects on crack growth, summarized in Reference 2. The input data for the spectra generated for that study are listed in Appendix C.

Gaussian Time History Generation

The theory used in formulating the program is described in Reference 2. The basic equation used in forming the random stress history is,

$$x_t = \sqrt{2} \sum_{K=0}^{N-1} D_K \cos (2\pi\omega_K t + B_K) \tag{1}$$

where the term D_K is defined in Figure 1. Making the substitution $D_K = \sqrt{S_K \Delta\omega}$ and assuming $\Delta\omega$ is constant throughout the summation described by Equation 1, that equation can be re-written,

$$x_t = \sqrt{2\Delta\omega} \sum_{K=0}^{N-1} \sqrt{S_K} \cos (2\pi\omega_K + B_K) \tag{2}$$

Rather than solving this equation directly, considerable efficiency is attained by use of the Fast Fourier Transform (FFT) outlined in Reference 3. The FFT computes N points in the random time history for N input values of A_K, where A_K is computed,

$$\text{Re } A_K = \sqrt{2\Delta\omega} \sqrt{S_K} \cos B_K \tag{3}$$

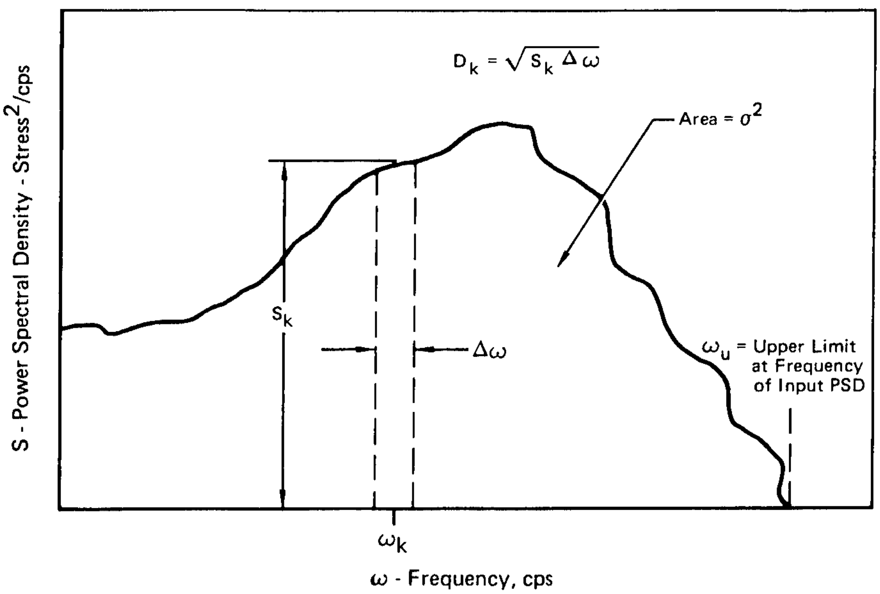


FIGURE 1. POWER SPECTRAL DENSITY USED IN RANDOM STRESS HISTORY GENERATION

$$\text{Im } A_K = \sqrt{2\Delta\omega} \ \sqrt{S_K} \ \sin B_K \tag{4}$$

Summarizing the generation of Gaussian random time histories:

- o "N" values of PSD (S_K) are determined from the PSD curve corresponding to K = 0, 1, ..., N-1
- o "N" random phase angles (B_K) between 0 and 2π are generated.
- o An array of N complex coefficients, A_K, are calculated as shown in Equations (3) and (4).
- o The Fast Fourier Transform is used to generate a time history of N values of load factor x_t, as defined by Equation (2).

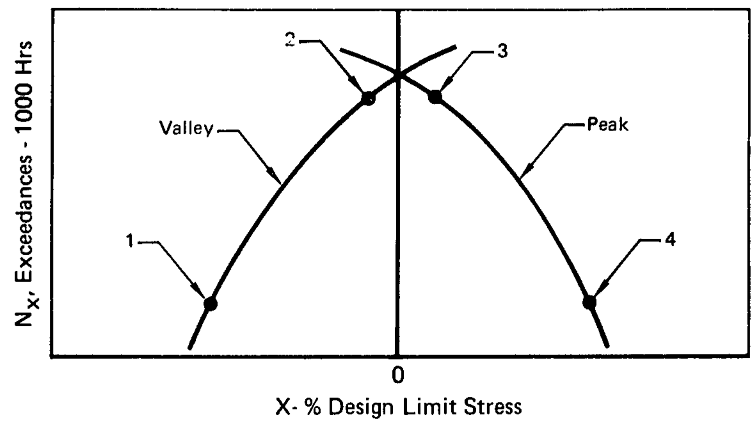
Mapping of Gaussian Process to Real

The exceedance curve for a Gaussian random time history is symmetrical with zero mean, as depicted in Figure 2. Actual exceedance curves for fighter aircraft are asymmetrical with a non-zero mean, also depicted in Figure 2, Gaussian random histories are adjusted so that exceedance curves for the Gaussian process and the actual exceedance curves are matched. This is accomplished using the transformations:

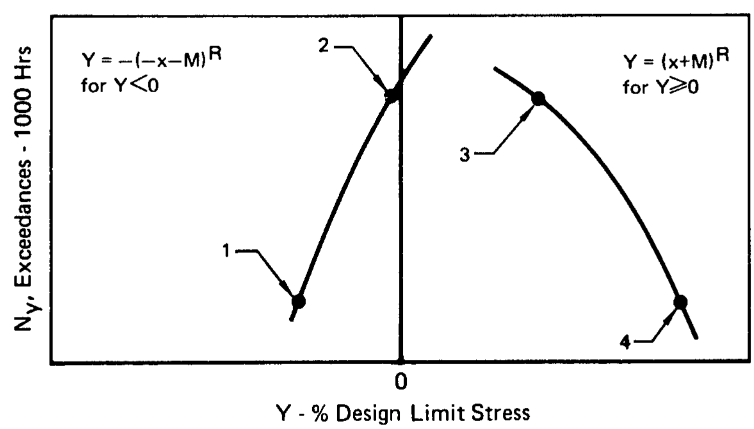
$$y = (x + M)^R \quad \text{for positive } x + M \tag{5}$$

$$y = -(-x - M)^R \quad \text{for negative } x + M \tag{6}$$

Numbered points are used to transform the
Gaussian data to the actual process



Exceedance Curve for Gaussian Random
Time History is Symmetrical with a Zero Mean



Actual Exceedance Curves are
Asymmetrical with a Non-Zero Mean

FIGURE 2. COMPARISON OF EXCEEDANCE CURVES

and conversely,

$$x = y^{1/R} - M \qquad \text{for positive } y \tag{7}$$

$$x = -(-y)^{1/R} - M \qquad \text{for negative } y \tag{8}$$

The exceedance curve for the Gaussian process is:

$$N_x = N_p\, P(x/a\sigma) + N_o[1 - P(x/b\sigma)]e^{-x^2/2\sigma^2} \tag{9}$$

This equation also describes the exceedance curve for the actual process when the substitutions indicated by Equations (7) and (8) are performed. The values M, R, N_p and σ are unknowns, and are determined through a trial and error process by the user. Using the actual exceedance curves, two points on the valley curve and two points on the peak curve are selected. This results in four sets of values of N and y. By using Equation (9) in combination with Equations (7) and (8), four non-linear simultaneous equations can be written, relating N and y with M, R, N_p, and σ as the unknowns.

The ratio N_o/N_p can be determined for any given PSD shape using Equations (10) and (11),

$$N_o^2 = \frac{\int_0^{\omega_u} \omega^2 S(\omega) d\omega}{\int_0^{\omega_u} S(\omega) d\omega} \tag{10}$$

$$N_p^2 = \frac{\int_0^{\omega_u} \omega^4 S(\omega) d\omega}{\int_0^{\omega_u} \omega^2 S(\omega) d\omega} \tag{11}$$

The values of M and R are required for program input. The area of the PSD vs frequency plot is σ^2, i.e.,

$$\sigma^2 = \int_0^{\omega_u} S_\omega d\omega \tag{12}$$

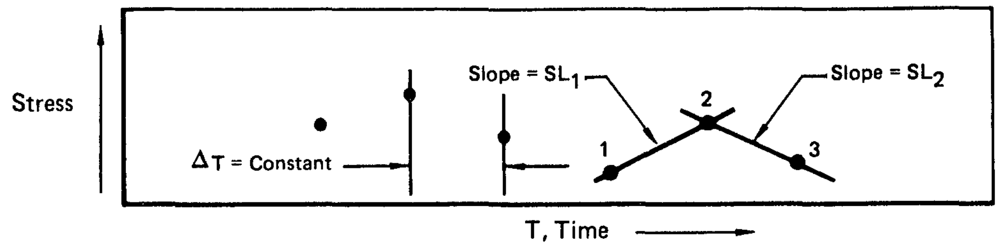
The value of σ can be employed by the user to scale the input values of PSD to obtain the proper area.

Search for Peaks and Valleys

The time history generated by the technique outlined in the previous sections results in a series of stress values at constant time intervals, as depicted in the following sketch. The presence of a peak or valley is detected when there is a difference in sign of slope between two consecutive sets of points. The value of the peak or valley is determined by assuming a quadratic relation of the form,

$$x = C1 + C2\ t + C3\ t^2 \tag{13}$$

and solving for the maximum value of x.



<u>Rise and Fall Counting</u>

Counting accelerometers and VGH recorders are the primary basis of measuring the service experience of fighter aircraft, summarized in exceedance tables. This data, obtained from flight measured accelerations, has a rise and fall counting criterion applied to eliminate small load factor excursions. For example, VGH recorders require from .4g to 1.2g rise or fall, depending on the g level, before the peak or valley is counted. In a similar manner, the simulated real time stress time history is filtered, using input rise and fall criteria, in order to eliminate excursions that the user does not wish to consider.

2. PROGRAM OUTLINE

This program, based on random noise theory, generates random time histories for baseline spectra. The program is based on the theory described in Reference 2, and summarized in Section 1. Input to the program includes control numbers, the number of time points to be computed, the PSD as a function of frequency, an initial number to be used in the random number generator, the rise and fall criteria to be used for cycle counting, and Gaussian to simulated real transformation constants. Output includes a sequential list of peaks and valleys. Input and output are described in Sections 3 and 4, respectively.

The procedure used in developing the stress random time history is outlined in Figure 3. The first step is the reading of the input by the main program, and printing of the input. This is followed by computation of the A(K) coefficients described by Equations (3) and (4), where S(K) is the PSD, and B(K) is a random phase angle, computed using the techniques described in Reference 1. With the A(K) coefficients determined, subroutine HARM is called, which transforms the A(K) values into the Gaussian random time history. The main program stores the real part of the Gaussian time history in the last half of the A(K) matrix, searches for peaks and valleys and stores the peaks and valleys in the first half of the A(K) matrix and equations (9), (10), and (11). The main program then prints the Gaussian occurrence and exceedance tables.

Next, the main program tabulates the actual Gaussian peak and valley occurrence and exceedance arrays as determined from the list of peaks and valleys. Subroutine EXCED is then called, which computes the theoretical exceedance array, based on the input PSD values. The main program then prints the Gaussian occurrence and exceedance tables.

The next process is the transformation of the Gaussian process peak and valley stress history into a simulated real peak and valley stress history using the technique outlined in Section 1. The main program then tabulates the actual transformed peak and valley occurrence and exceedance arrays as determined from the list of transformed peaks and valleys. Subroutine EXCEED is again called, to compute the theoretical exceedance table, based on the input PSD values and transformation constants. The main program then prints the transformed peak and valley occurrence and exceedance tables.

Subroutine FILTER is called to apply the input rise and fall criteria to the transformed, i.e., simulated real peak and valley stress history. The main

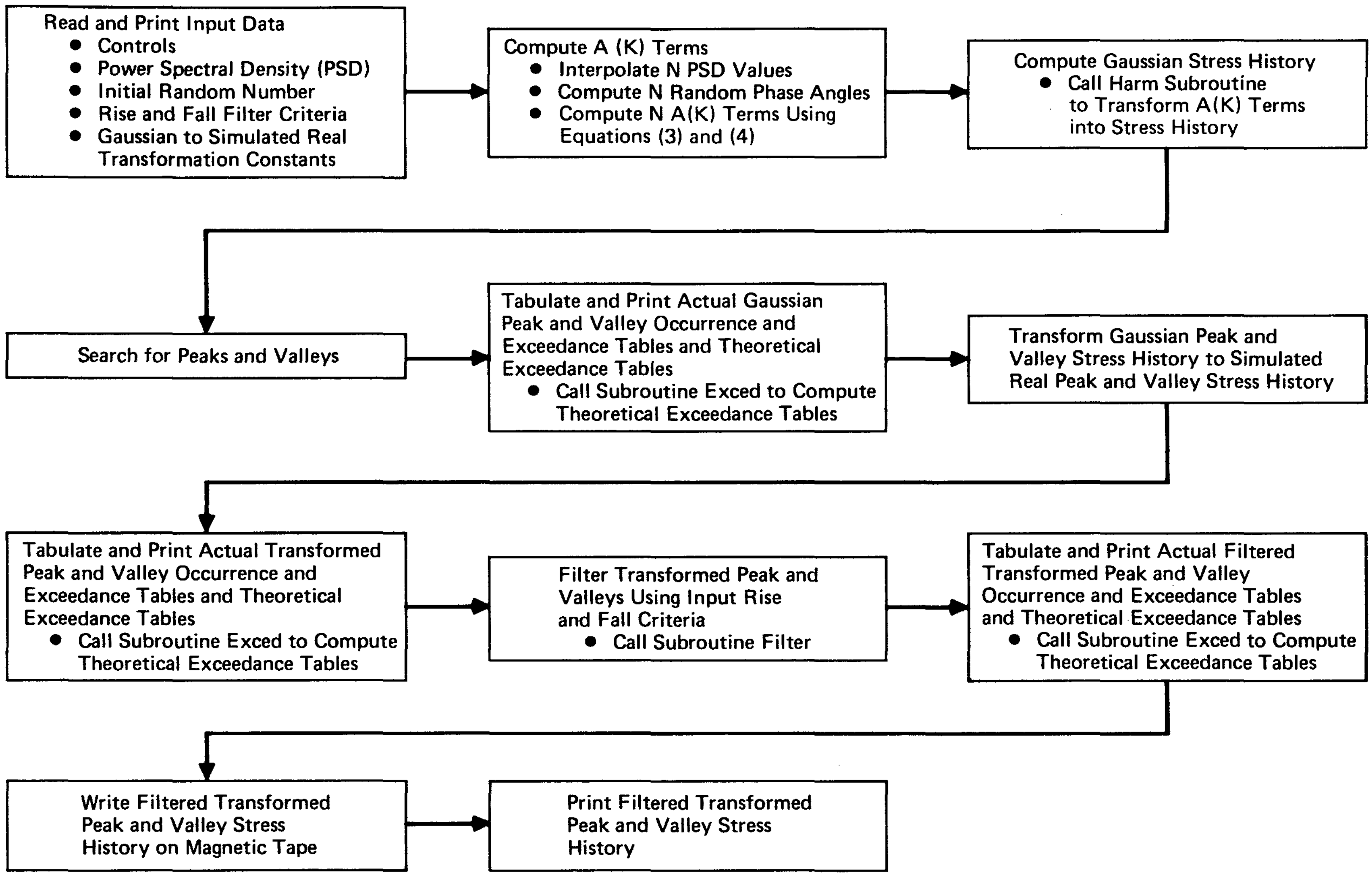


FIGURE 3. PROCEDURE USED IN DEVELOPING STRESS RANDOM TIME HISTORY

program then tabulates the actual occurrence and exceedance arrays based on the filtered transformed history. Subroutine EXCEED is again called, to compute the theoretical exceedance table, based on the input PSD values and transformation constants. The main program then prints the filtered transformed peak and valley occurrence and exceedance tables.

Finally, the filtered simulated loads are recorded on magnetic tape or disk for use by the program described in Volume II and then printed.

The program consists of a main program and five subroutines, outlined in Figure 4. The function of each subroutine is described in the following paragraphs.

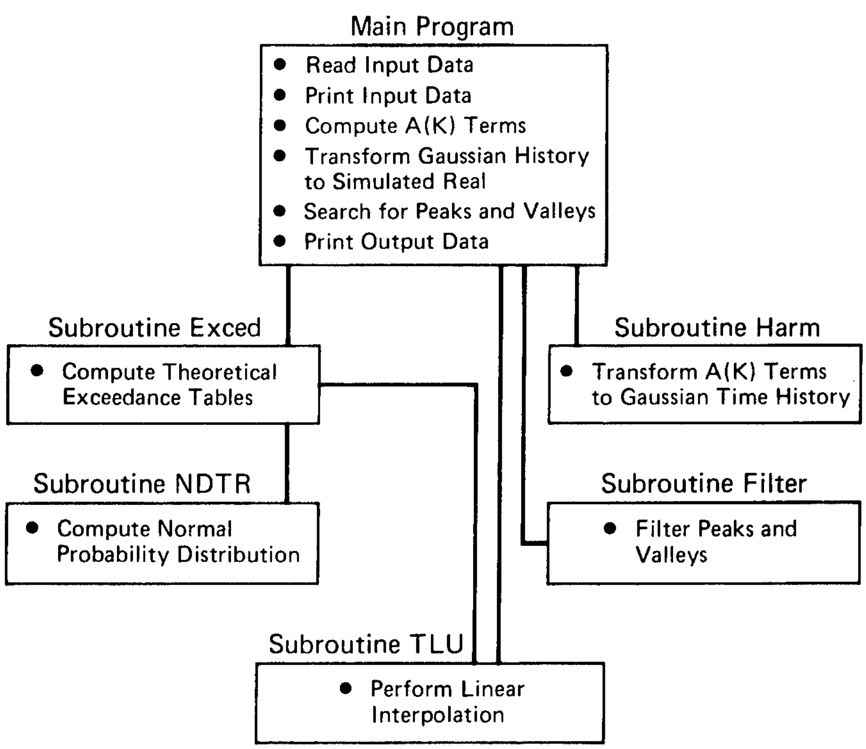


FIGURE 4. SUBROUTINES USED IN DEVELOPING STRESS RANDOM TIME HISTORY

Main Program

The main program reads and prints the input data. The A(K) coefficients are computed, and subroutine HARM is called, which transforms the A(K) values into the Gaussian random time history. The time history is searched to determine peaks and valleys. The main program transforms the Gaussian peak and valley values to simulated real values. The actual occurrence and exceedance arrays for the Gaussian values, transformed values, and filtered transformed values are tabulated by the main program. All output is printed or written by the main program.

Subroutine EXCED

This subroutine computes theoretical exceedance tables for the Gaussian and transformed, i.e., simulated real stress time histories. The solution for the Gaussian time history is obtained from the equation for exceedance per unit time, Equation (9), where N_o and N_p are computed from Equations (10) and (11). The Gaussian exceedance is computed

$$N_{Total,x} = t \times N_x \tag{14}$$

where t is the time period represented by the input values of PSD maximum frequency ω_u, and the number of computed time points. The theoretical exceedances for the transformed stress history is also obtained from Equation (9), with transformation indicated by Equations (7) and (8),

$$N_{Total,y} = t \times N_y \tag{15}$$

Subroutine TLU

This subroutine provides a linear interpolation table look-up procedure. Input to the routine is a list of independent and dependent values, x and y, the number of points in this list, NOPTS, and the independent value for which interpolation is desired, XVAL. Output of the routine is interpolated value of the dependent value, YVAL. When the range of the table is exceeded, linear extrapolation is used.

Subroutine FILTER

This subroutine applies the rise and fall criteria to the transformed peak and valley list.

Filtering is accomplished by using the input values P_{MAX} and P_{MIN} on adjacent half cycles throughout the time history. A peak and valley that meets either the P_{MAX} or P_{MIN} rise and fall criteria is counted only if the succeeding half cycle exceeds the remaining rise and fall criterion. If a half cycle fails to exceed the proper rise or fall requirement, the non-qualifying peak or valley is removed from the time history. The two adjacent peaks or valleys are now compared, resulting in the retention of either the largest peak or the smallest valley. The process continues by checking to see if the next half cycle exceeds the remaining rise and fall criterion. For example, in Figure 5, ranges 4-5, 6-7, 7-8, 9-10, 10-11, 11-12, and 12-13 do not meet the rise and fall criterion. Sequential applications of the filtering checks results in the load sequence shown as "Fourth Pass".

Subroutine HARM

For one dimension, as used in this program, the HARM subroutine, described fully in Reference 3, computes the complex Fourier series,

$$X(J) = \sum_{K=o}^{N-1} A(K)\ e^{2\pi i\ JK/N} \qquad (16)$$

where J = 0, 1 ---- N-1

The theory of the transformation is described in Reference 3. Input to the subroutine consists of N, the real and imaginary parts of A(K), and the value of IFSET. Although the routine is capable of transforming three-dimensional arrays, in this program only a single dimensional array is required. Therefore, M(1) = M1 where $N = 2^{M1}$ is the number of time points to be computed, and M(2) = M(3) = 0. The real and imaginary parts of A(K) are computed by the main program, as previously described. IFSET is an option parameter which is set to 1 in order to have the routine calculate the Fourier transform.

Output of the routine is the history X(J) stored in the A(K) matrix. The real part of A(K) is stored in even numbered locations and the imaginary part of A(K) is stored in odd numbered locations, sequentially. Subroutine HARM is a portion of the IBM Scientific Subroutine Package.

Subroutine NDTR

This subroutine is called by subroutine EXCED, in order to compute the theoretical exceedance table. The subroutine computes the normal probability distribution

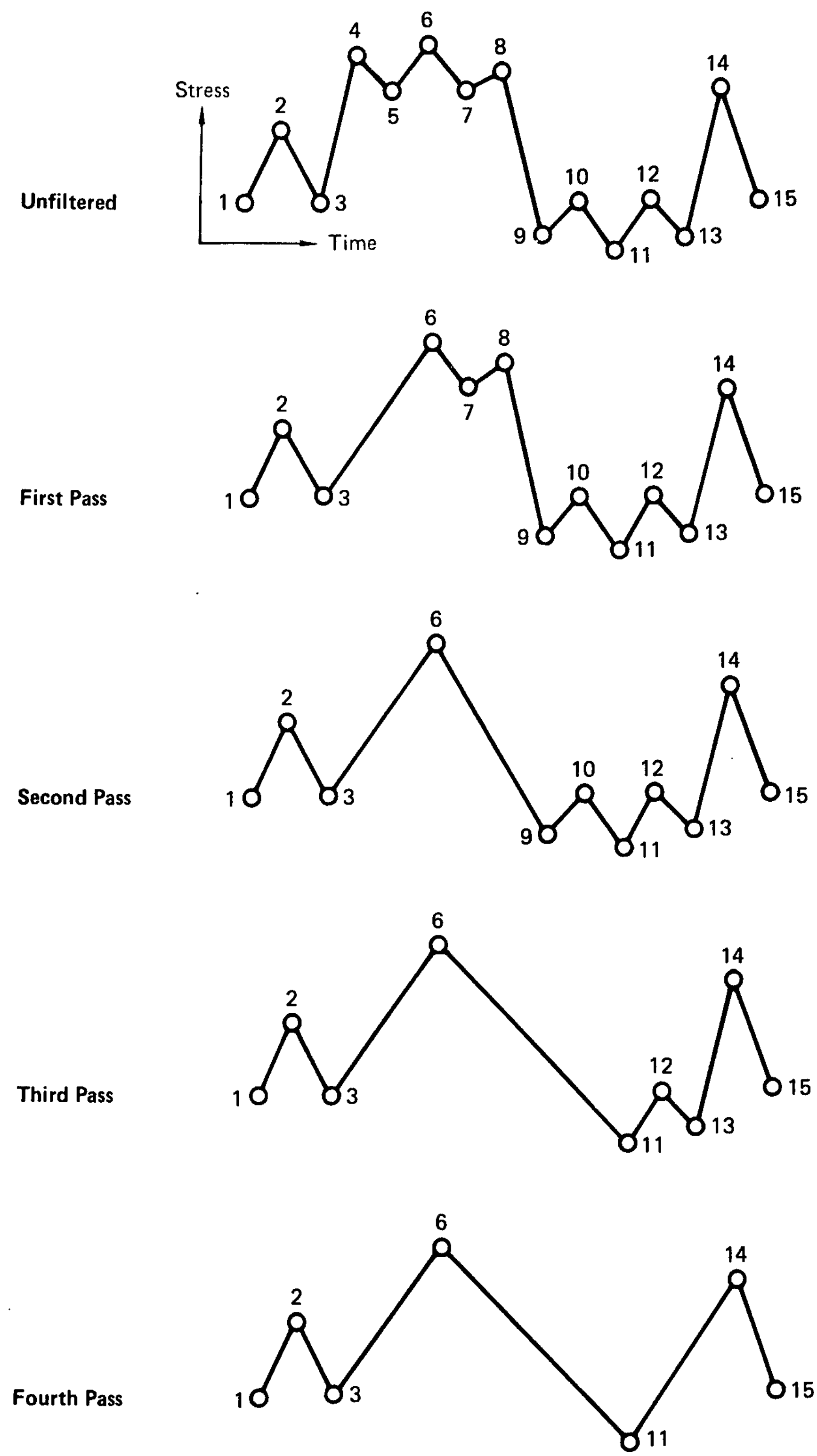


FIGURE 5. APPLICATION OF FILTERING RULES TO STRESS HISTORY

$$y = P(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{\infty} \exp\ (-u^2/2)du \tag{17}$$

The following approximation is used:

$$P\ (x) = 1 - f(x) \sum_{i=1}^{5} a_i w^i;\ x \geq 0 \tag{18}$$

where

$w = 1/(1 + px)$

$f(x) = \exp\ (-x^2/2)/\sqrt{2\pi}$

$p = 0.2316419$

$a_1 = 0.3193815$

$a_2 = -0.3565638$

$a_3 = 1.781478$

$a_4 = -1.821256$

$a_5 = 1.330274$

The theory is described in Reference 4. Subroutine NDTR is a portion of the IBM Scientific Subroutine Package.

3. INPUT DATA REQUIREMENTS

Input to the program consists of the number of time points to be computed, the power spectral density (PSD) as a function of frequency, the rise and fall criteria to be used with cycle counting, and an initial number to be used in the random number generator. The input data format is described in the computer program listing, via comment cards, Appendix A. Example input is presented in Appendix B.

The maximum number of time points that may be computed in a single case is 2^{15} = 32,678. The number of time points to be computed is controlled by an input control number, and may be any power of 2, up to the maximum value.

The power spectral density is usually input as (% Design limit stress)^2 vs frequency, cps. Program input includes the number of points to be input, and the frequency and PSD value for each of the input points. Experience has shown that many peaks and valleys will be missed if the upper limit of the PSD plot is not artificially extended with zero values for PSD, as depicted in Figure 6. The time represented by the input values of PSD upper frequency and the number of time points to be computed is,

$$t = \frac{N}{\omega_u}$$

By increasing ω_u artificially, the time t is reduced for a given number of time points, N, effectively increasing the number of points per unit time and hence per peak. Trial runs have shown that the use of NR' = 2^{NR} = 4, as defined in Figure 6, will usually result in adequate sensitivity and peaks and valleys will not be missed.

The HARM subroutine requires as input a value of A(K) for each time point computed. Each value of A(K) requires a value of PSD to be interpolated. Because the number of time points to be computed, typically 32,768, is usually much larger than required to adequately define the shape of the PSD plot, constant values of PSD are used in ranges, as shown in the example of Figure 6. In that example, the number of time points is 128 and the frequency scale has been multiplied by four to increase the sensitivity of the output. Therefore, 128/4 = 32 values of PSD are required in the computation of the A(K) terms. In this example, 8 constant values of PSD are used to represent the 32 required values.

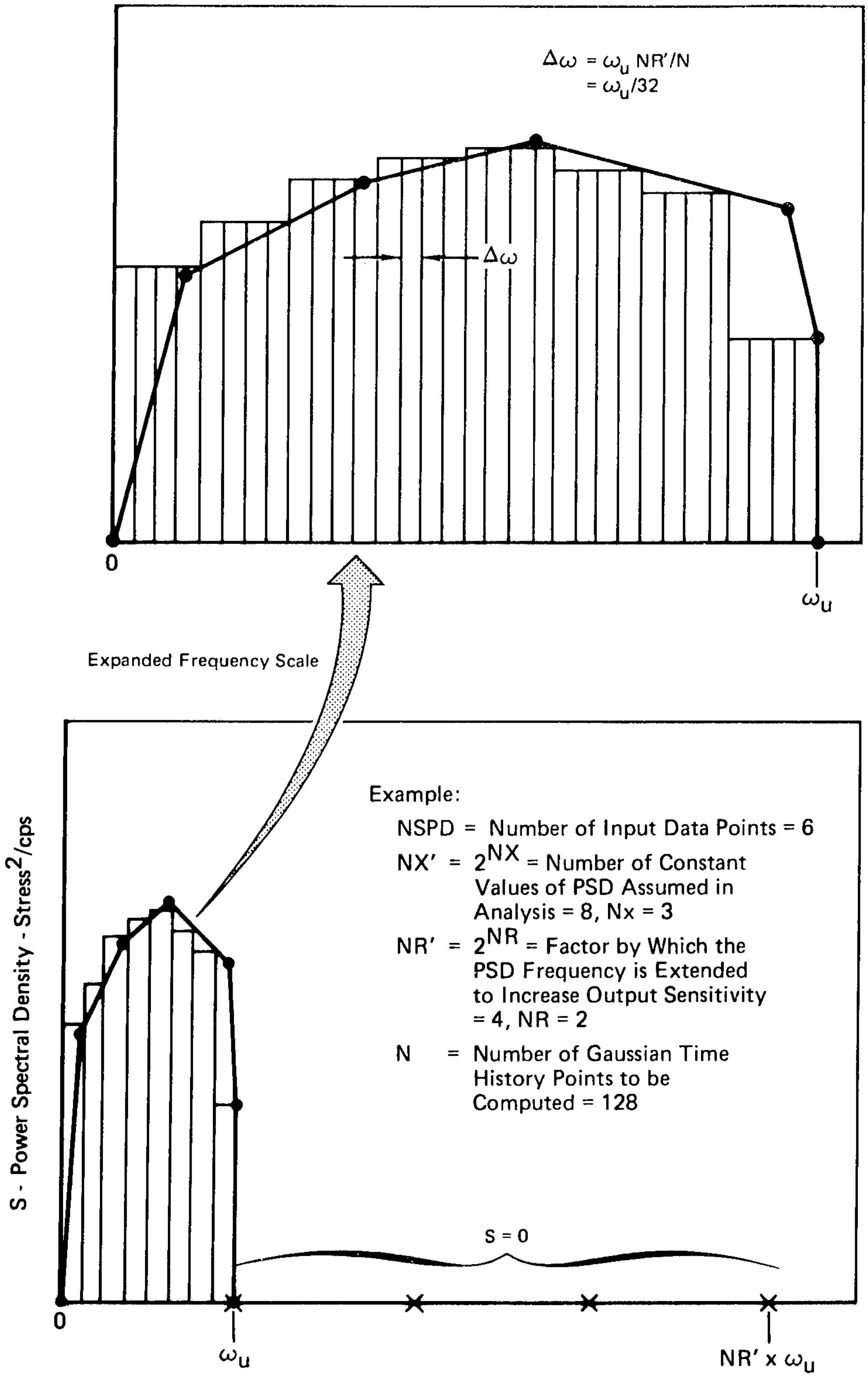


FIGURE 6. EXAMPLE OF PSD INPUT FOR RANDOM LOAD HISTORY

Other input to the program controls the size and sensitivity of the occurrence and exceedance tables.

As described in the explanation of subroutine FILTER in Section 2, input rise and fall criteria are applied to the transformed peak and valley list. Peaks and valleys that do not meet the required rise and fall criteria are removed from the time history.

Transformation of the Gaussian to simulated real time history is controlled thru input of the values, M and R, defined by Equations (5) and (6).

4. OUTPUT DESCRIPTION

The output consists of six sections. The first section is an echo of the input to permit a check.

The second section contains the elapsed time represented by the number of time points generated and the upper frequency of the PSD plot, and the theoretical values of N_o and N_p as defined by Equations (10) and (11).

The third section contains the occurrence and exceedance tables for the Gaussian time history. First the peak and valley occurrences are printed for the time period considered, then the exceedances for that time period are printed. This is followed by a list of the theoretical exceedances as computed by Equation (9). The next output is the total number of peaks and valleys in the Gaussian time history multiplied by two, and the most current value of the random number, IX.

The fourth section contains the occurrence and exceedance tables for the transformed, i.e., simulated real, time history. The output format is similar to that for the third section. The next output is the total number of peaks and valleys in the transformed time history, multiplied by two; this number is the same as for the Gaussian history.

The fifth section contains the occurrence and exceedance tables for the filtered transformed time history, in a format similar to that for the third section. The next output is the total number of peaks and valleys in the filtered transformed time history, multiplied by two.

The sixth section of output is a list of filtered transformed peaks and valleys in sequential order as created by this simulation process.

Example output is presented in Appendix B.

5. REFERENCES

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2. Dill, H. D., and Saff, C. R., "Effect of Fighter Attack Spectrum on Crack Growth," AFFDL-TR-76-112, November 1976.
3. Cooley, J. W., and Tukey, J. W., "An Algorithm for the Machine Calculation of Complex Fourier Series," Mathematics of Computations, Vol. 19, April 1965, p. 297.
4. System/360 Scientific Subroutine Package, Version III, Programmer's Manual, IBM Report GH20-0205-4, August 1970.

APPENDIX A PROGRAM LIST

```
LEVEL 21.7 ( JAN 73 )                              OS/360   FORTRAN H

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=55,SIZE=0000K,
                            SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,NOXREF
                C
                C                             SPECGN1
                C THIS PROGRAM GENERATES THE GAUSSIAN RANDOM TIME HISTORY DATA.
                C THE PROGRAM WAS WRITTEN AT MCDONNELL AIRCRAFT COMPANY FOR THE
                C IBM 370-195 OS USING FORTRAN IV DURING SEPTEMPER OF 1975 BY
                C HAROLD DILL,CHARLES WILSON AND TOM YOUNG...
                C
ISN 0002              REAL MEAN
ISN 0003              INTEGER ANDZ
ISN 0004              DIMENSION A(65536),S(8192),INV(8192),M(3),PSD(256),W(256)
                     1,NPEAKS(60,4),PL(60,2)
ISN 0005              IN=5
ISN 0006              IO=6
ISN 0007              IPASS=0
ISN 0008         7777 IFIN=0
                C
                C THE INPUT DATA FOLLOWS...
                C
                C
                C                     INPUT DATA REQUIREMENTS
                C                     ----- ---- ------------
                C
                C
                C             INPUT TO THE PROGRAM CONSISTS OF THE NUMBER OF TIME POINTS
                C         TO BE COMPUTED, THE POWER SPECTRAL DENSITY (PSD) AS A FUNCTION
                C         OF FREQUENCY, THE RISE AND FALL CRITERIA TO BE USED WITH CYCLE
                C         COUNTING, AND AN INITIAL NUMBER TO BE USED IN THE RANDOM
                C         NUMBER GENERATOR.
                C
                C
                C         INPUT DATA FORMAT
                C         ----- ---- ------
                C
                C         THE PROGRAM INPUT IS:
                C         M1,NR,NX,NSPD,IX                              5I5
                C         W(1),PSD(1),W(2),PSD(2),W(3),PSD(3)           6E10.0
                C         W(4),PSD(4),W(5),PSD(5),W(6),PSD(6)           6E10.0
                C         ... W(NPSD),PSD(NPSD)                         6E10.0
                C         NDZ,DZ,PMAX,PMIN,MEAN,R,INC                   I5,F5.0,4E10.0
                C         ANDZ,ADZ                                      I5,F5.0
                C
                C         WHERE:
                C
                C         N=2**M1     = NUMBER OF POINTS TO BE COMPUTED IN THE RANDOM TIME
                C                       HISTORY, M1 MAX. IS 15, N MAX. IS 32768.
                C         NR'=2**NR = FACTOR BY WHICH THE PSD FREQUENCY AXIS IS EXTENDED
                C                       TO INCREASE THE SENSITIVITY OF THE OUTPUT.
                C                       NR=2,NR'=4 IS TYPICAL.  TRIAL RUNS HAVE SHOWN
                C                       THAT MANY PEAKS WILL BE MISSED IF THE VALUES NR=0,
                C                       NR'=1 ARE USED.
                C         NX'=2**NX = NUMBER OF DIVISIONS OF THE PSD GRAPH USED
                C                       IN ANALYSIS.
```

```
C         NSPD        = NUMBER OF INPUT DATA POINTS ON THE PSD VS
C                       FREQUENCY GRAPH.
C         IX          = INTEGER USED AS STARTING SEED IN RANDOM NUMBER
C                       GENERATION.
C         W(I),PSD(I)
C                     = FREQUENCY AND VALUE OF PSD.
C         NDZ         = NUMBER OF INCREMENTS TO BE USED IN THE OUTPUT
C                       OF GAUSSIAN PEAK AND VALLEY EXCEEDANCE TABLES.
C          NZ          = VALUE OF THE INCREMENT TO BE USED IN OUTPUT OF
C                        OF GAUSSIAN PEAK AND VALLEY EXCEEDANCE TABLES.
C
C         THE SECOND SET OF VALUES OF ANDZ AND ADZ INDICATED IN THE
C         INPUT ARE USED FOR OUTPUT OF THE EXCEEDANCE TABLE FOR THE
C         SIMULATED REAL TIME HISTORY.
C
C          PMAX,PMIN = IN ORDER FOR A PEAK AND VALLEY TO BE COUNTED
C                      AND INCLUDED IN THE OUTPUT LIST, THE MAXIMUM
C                      RISE OR FALL MUST EXCEED THE INPUT VALUE OF
C                      PMAX, AND THE MINIMUM RISE AND FALL MUST
C                      EXCEED THE INPUT VALUE OF PMIN.  IF THE MAXIMUM
C                      RISE OR FALL EXCEEDS PMAX, AND THE MINIMUM
C                      RISE OR FALL EXCEEDS PMIN, THE CYCLE IS
C                      COUNTED.
C          MEAN       = MEAN VALUE IN MAPPING GAUSSIAN TO SIMULATED REAL
C                      TIME HISTORY.
C          R          = TRANSFORMATION EXPONENT USED IN MAPPING GAUSSIAN
C                      TO SIMULATED REAL TIME HISTORY.
C          INC        = INDICATOR USED TO CONTROL ADJUSTMENT OF
C                      SIMULATED REAL TIME HISTORY.
C                        INC = 1, NO ADJUSTMENT IS MADE.
C                        INC = 0, ADJUSTMENT IS MADE.
C         THIS ADJUSTMENT CAPABILITY WAS INCORPORATED IN THE PROGRAM
C         IN ORDER TO MATCH THE BASELINE AIR-TO-GROUND EXCEEDANCE
C         CURVES, WHICH HAVE NO PEAKS GREATER THE 80% DLS.  IF INC=0
C         ALL PEAKS GREATER THE 80% AND LESS THAN 90% DLS ARE RE-SET
C         TO 80% DLS.
ISN 0009         IF(IPASS.EQ.0)READ(IN,1001,END=8888)M1,NR,NX,NSPD,IX
ISN 0011         IF(IPASS.EQ.1)READ(IN,7001,END=8888)IX
ISN 0013    7001 FORMAT( I5 )
ISN 0014         WRITE(IO,3001)M1,NR,NX,NSPD,IX
ISN 0015    3001 FORMAT(' M1=',I5,'   NR=',I5,'   NX=',I5,'   NSPD=',I5,
               *  '   IX=',I5)
ISN 0016         IF(IPASS.EQ.0)READ(IN,1002)(W(I),PSD(I),I=1,NSPD)
ISN 0018         WRITE(6,79)
ISN 0019      79 FORMAT(//'    I         W(I)          PSD(I)',/)
ISN 0020         WRITE(6,81)(I,W(I),PSD(I),I=1,NSPD)
ISN 0021      81 FORMAT(I5,2E15.7)
ISN 0022         M(1)=M1
ISN 0023         M(2)=0
ISN 0024         M(3)=0
ISN 0025         N=2**M1
ISN 0026         N2 =2*N
ISN 0027         IF(IPASS.EQ.0)NXX=NX
```

```
ISN 0029          IF(IPASS.EQ.0)NRR=NR
ISN 0031          IF(IPASS.EQ.1)NX=NXX
ISN 0033          IF(IPASS.EQ.1)NR=NRR
ISN 0035          NX=2**NX
ISN 0036          NR=2**NR
ISN 0037          N1=N/(NX*NR)
ISN 0038          IFSET=1
ISN 0039          DW=W(NSPD)/NX/N1
ISN 0040     1004 FORMAT(/' ANDZ =',I5,'          ADZ =',F5.0)
ISN 0041          TIME=N
ISN 0042          TIME=TIME/(NR*W(NSPD)*3600.)
ISN 0043     3004 FORMAT(//' THE ELAPSED TIME FOR THIS RUN IS',F12.6,' HOURS.'/)
ISN 0044              IX=IX+500
ISN 0045          IX=IX*2+1
ISN 0046          IF(IPASS.EQ.0)READ(IN,1003)NDZ,DZ,PMAX,PMIN,MEAN,R,INC
ISN 0048          IF(IPASS.EQ.0)NNDZ=NDZ
ISN 0050          IF(IPASS.EQ.0)DDZ=DZ
ISN 0052          IF(IPASS.EQ.1)NDZ=NNDZ
ISN 0054          IF(IPASS.EQ.1)DZ=DDZ
ISN 0056          IF(IPASS.EQ.0)READ(IN,1003) ANDZ,ADZ
ISN 0058          IPASS=1
ISN 0059          WRITE(6,82) NDZ,DZ,PMAX,PMIN,MEAN,R,INC
ISN 0060          WRITE(IO,1004)ANDZ,ADZ
ISN 0061          WRITE(IO,3004) TIME
ISN 0062       82 FORMAT(//6X,'NDZ =',I7,10X,'DZ =',E15.7,10X,'PMAX =',F10.2,
                 *10X,'PMIN =',F10.2//6X,'MEAN =',F10.3,10X,'R =',F10.3,
                 *10X,'INC =',I5,10X//)
ISN 0063          K=0
            C
            C THE FOLLOWING DO LOOP COMPUTES THE  A(K)  TERMS...
            C
ISN 0064          DO 10 I=1,NX
ISN 0065          WI=DW*I*N1
ISN 0066          CALL TLU(W,PSD,NSPD,WI,S2)
ISN 0067          S2=SQRT(S2*2.0*DW)
ISN 0068          DO 5 J=1,N1
ISN 0069          K=K+1
ISN 0070          IX=IX*1029
ISN 0071          NIX=IX/1048576
ISN 0072           IX=IX-NIX*1048576
ISN 0073          B=IX/166886.
ISN 0074          A(K)=S2*COS(B)
ISN 0075          K=K+1
ISN 0076          A(K)=S2*SIN(B)
ISN 0077        5 CONTINUE
ISN 0078       10 CONTINUE
ISN 0079          K1=K+1
ISN 0080          IF(K1.GE.N2) GO TO 16
ISN 0082          DO 15 K=K1,N2
ISN 0083       15 A(K)=0.
ISN 0084       16 CONTINUE
ISN 0085          CALL HARM(A,M,INV,S,IFSET,IFERR)
            C
```

```
                 C THE  A  MATRIX IS NOW THE TIME HISTORY...
                 C A(ODD) 1,3,5,....,ETC IS THE REAL PART...
                 C A(EVEN) 2,4,6,....,ETC IS THE IMAGINARY PART...
                 C
ISN 0086               IFSET=2
ISN 0087               IF(IFERR.NE.0) STOP 100
ISN 0089               DO 20 I=1,4
ISN 0090               DO 20 J=1,60
ISN 0091            20 NPEAKS(J,I)=0
                 C
                 C THE REAL PART OF THE  A  MATRIX IS MOVED TO THE LATTER PART
                 C OF THE  A  MATRIX...
                 CC
ISN 0092               K=N2
ISN 0093               NM1=N2-1
ISN 0094               DO 30 I=1,NM1,2
ISN 0095               A(K)=A(N2-I)
ISN 0096            30 K=K-1
                 C
                 C SEARCH FOR PEAKS AND VALLEYS AND THEN STORE THE VALUE AND TIME
                 C IN THE FIRST PART OF THE  A  MATRIX...
                 C
ISN 0097               IA1=N+1
ISN 0098          95   CONTINUE
ISN 0099               K=0
ISN 0100               NMAX=N-1
ISN 0101               SL2=A(IA1+1)-A(IA1)
ISN 0102               Y1=A(IA1+1)
ISN 0103               DO 60 I=2,NMAX
ISN 0104               SL1=SL2
ISN 0105               SL2=A(IA1+I)-A(IA1+I-1)
ISN 0106               NSL=SL1/ABS(SL1)-SL2/ABS(SL2)
ISN 0107               IF(NSL)40,60,40
ISN 0108            40 C1=A(IA1+I-2)
ISN 0109               C2=(3*SL1-SL2)/2.
ISN 0110               C3=(SL2-SL1)/2.
ISN 0111               XM=-C2/(2.*C3)
ISN 0112               X1=I-1
ISN 0113               XM=XM+X1
ISN 0114               YM=C1-C2**2/(4.*C3)
ISN 0115               A(K+1)=XM/NR/W(NSPD)
ISN 0116               A(K+2)=YM
ISN 0117               IZ=ABS(YM)/DZ+1
ISN 0118               IF(IZ.GT.(NDZ+1)) IZ=NDZ+1
ISN 0120               IF(YM.LT.0.) IZ=IZ+NDZ+1
ISN 0122               KZ=1
ISN 0123               IF(NSL.LT.0)KZ=2
                 C
                 C SET UP A GAUSSIAN PEAK AND VALLEY OCCURENCE TABLE...
                 C
ISN 0125               NPEAKS(IZ,KZ)=NPEAKS(IZ,KZ)+1
ISN 0126               K=K+2
ISN 0127            60 CONTINUE
```

```
ISN 0128            KKK=K
ISN 0129            NPKR=K
ISN 0130      4451  NDZ1=NDZ+1
ISN 0131            I1=NDZ
ISN 0132            NPEAKS(NDZ1,3)=NPEAKS(NDZ1,1)
ISN 0133            NPEAKS(NDZ1,4)=NPEAKS(NDZ1,2)
ISN 0134            NDZ2=2*NDZ1
ISN 0135            NPEAKS(NDZ2,3)=NPEAKS(NDZ2,1)
ISN 0136            NPEAKS(NDZ2,4)=NPEAKS(NDZ2,2)
ISN 0137      445   I2=NDZ2-1
ISN 0138            DO 70 I=1,NDZ
ISN 0139            DO 75 K=1,2
ISN 0140            NPEAKS(I1,K+2)=NPEAKS(I1+1,K+2)+NPEAKS(I1,K)
ISN 0141            NPEAKS(I2,K+2)=NPEAKS(I2+1,K+2)+NPEAKS(I2,K)
ISN 0142      75    CONTINUE
ISN 0143            I1=I1-1
ISN 0144            I2=I2-1
ISN 0145        70  CONTINUE
ISN 0146            IF( IFIN.EQ.1 ) GO TO 91
ISN 0148            CALL EXCED(W,PSD,NSPD,NX,NDZ,DZ,F0,FP,PL,MEAN,R,IFIN,TIME)
ISN 0149            WRITE(IO,2001)
ISN 0150            DO 90I=1,NDZ1
ISN 0151            DNZ=DZ*I
ISN 0152            DNZ1=DZ*(I-1)
              C
              C WRITE THE PEAK EXCEEDANCE TABLE...
              C
ISN 0153            WRITE(IO,2002) DNZ1,DNZ,(NPEAKS(I,J),J=1,4),PL(I,1)
ISN 0154        90  CONTINUE
ISN 0155            DO 100 I=1,NDZ1
ISN 0156            DNZ=-DZ*I
ISN 0157            DNZ1=-DZ*(I-1)
ISN 0158            K=I+NDZ1
              C
              C WRITE THE VALLEY EXCEEDANCE TABLE...
              C
ISN 0159            WRITE(IO,2002) DNZ1,DNZ,(NPEAKS(K,J),J=1,4),PL(I,2)
ISN 0160      100    CONTINUE
ISN 0161       91   CONTINUE
ISN 0162            WRITE(IO,63) NPKR
ISN 0163       63    FORMAT(//' NPKR=',I10//)
ISN 0164            IF(IFIN.EQ.2) CALL FILTER(A,KKK,PMIN,PMAX,NPKR)
ISN 0166            IF(IFIN.EQ.2)K=NPKR
ISN 0168            IF(IFIN.EQ.2)GO TO 71
              C
              C WRITE THE FILTERED PEAK AND VALLEY TABLE...
              C
ISN 0170            IF(IFIN.EQ.3)WRITE(2)NPKR,(A(I),I=2,NPKR,2)
ISN 0172            IF( IFIN.EQ.3 ) WRITE(IO,1005)
ISN 0174            IF(IFIN.EQ.3)WRITE(6,72)(A(I),I=2,NPKR,2)
ISN 0176       72   FORMAT(10F10.1)
ISN 0177            IF(IFIN.EQ.3)GO TO 7777
ISN 0179            IF(IFIN.EQ.1) GO TO 69
```

```
ISN 0181            IFIN=1
ISN 0182       66   DO 2220 I=1,4
ISN 0183            DO 2220 J=1,60
ISN 0184     2220   NPEAKS(J,I)=0
ISN 0185            NDZ=ANDZ
ISN 0186            DZ=ADZ
ISN 0187            NSL=(A(4)-A(2))/ABS(A(4)-A(2))
              C
              C SET UP THE PEAK AND VALLEY OCCOURENCE TABLE THE
              C REAL - TRANSFORMED LOADS...
              C
ISN 0188            DO 660 I=2,NPKR,2
ISN 0189            NSL=-NSL
ISN 0190            YM=A(I)
ISN 0191            IZ=ABS(YM)/DZ+1
ISN 0192            IF(IZ.GT.(NDZ+1))IZ=NDZ+1
ISN 0194            IF(YM.LT.0.) IZ=IZ+NDZ+1
ISN 0196            KZ=1
ISN 0197            IF(NSL.LT.0)KZ=2
ISN 0199            NPEAKS(IZ,KZ)=NPEAKS(IZ,KZ)+1
ISN 0200      660   CONTINUE
ISN 0201            GO TO 4451
ISN 0202     1001   FORMAT(14I5)
ISN 0203     1002   FORMAT(6E10.0)
ISN 0204     1003   FORMAT(I5,F5.0,4E10.0,I5,E10.0)
ISN 0205     1005   FORMAT('1                  LIST OF FILTERED PEAKS AND VALLEYS'/
                   *'                  ---- -- -------- ----- --- -------'/)
ISN 0206     2001   FORMAT(6X,'NZ RANGE  PEAKS  VALLEYS  PEAK    VALLEY   THEORITICAL',
                   1 /31X,'EXCEED   EXCEED      EXCEED',/
                   *6X,55('='),/)
ISN 0207     2002   FORMAT(2X,F6.1,'-',F6.1,I7,I8,I8,I8,F12.1)
              C
              C TRANSFORMS THE GAUSSIAN PEAK AND VALLEY LIST TO REAL...
              C
ISN 0208       69   DO 64 I=2,NPKR,2
ISN 0209            A(I)=(ABS(A(I)+MEAN))**R*((A(I)+MEAN)/(ABS(A(I)+MEAN)))
ISN 0210            IF( INC.EQ.1 ) GO TO 64
ISN 0212            IF( A(I).GT.80.0 .AND. A(I).LT.90.0 ) A(I)=70.0
ISN 0214            IF( A(I).GT.90.0 ) A(I)=80.0
ISN 0216       64   CONTINUE
ISN 0217       71   IFIN=IFIN+1
ISN 0218            WRITE(IO,89) IX
ISN 0219       89   FORMAT(/' THE MOST CURRENT VALUE OF IX IS',I10/)
ISN 0220            GO TO 66
ISN 0221     8888   STOP 1776
ISN 0222            END
```

```
LEVEL 21.7 ( JAN 73 )                                    OS/360   FORTRAN H

      COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=55,SIZE=0000K,
                         SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,NOXREF
            C
            C
            C
            C
            C
            C
            C
            C
            C
ISN 0002              SUBROUTINE EXCED (W,PSD,NSPD,NX,NDZ,DZ,F0,FP,PL,MEAN,R,IFIN,TIME)
            C
            C   SUBROUTINE EXCEED COMPUTES THE THEORETICAL FXCEEDANCE TABLES
            C   BASED ON THE INPUT (PSD,R,MEAN)...
            C
ISN 0003              DIMENSION W(1),PSD(1),PL(60,2)
ISN 0004              REALMEAN
ISN 0005              REAL K1,K2
ISN 0006              IF( IFIN.EQ.0 ) WRITE(6,301)
ISN 0008          301 FORMAT('1          GAUSSIAN EXCEEDANCE TABLE'/
                     *  '          -------- ---------- -----'/)
ISN 0009              IF( IFIN.EQ.2 ) WRITE(6,302)
ISN 0011          302 FORMAT('1          REAL EXCEEDANCE TABLE UNFILTERED'/
                     *  '          ---- ---------- ----- ----------'/)
ISN 0012              IF( IFIN.EQ.3 ) WRITE(6,303)
ISN 0014          303 FORMAT('1          REAL EXCEEDANCE TABLE FILTERED'/
                     *  '          ---- ---------- ----- --------'/)
ISN 0015              VAR=0.
ISN 0016              SMOM=0.
ISN 0017              FMOM=0.
ISN 0018              DW=W(NSPD)/NX
ISN 0019              DO 10 I=1,NX
ISN 0020              WI=DW*I
ISN 0021              CALL TLU(W,PSD,NSPD,WI,S)
ISN 0022              VAR=S*DW+VAR
ISN 0023              SMOM=WI**2*S*DW+SMOM
ISN 0024           10 FMOM=WI**4*S*DW+FMOM
ISN 0025              F0=SMOM/VAR
ISN 0026              FP=FMOM/SMOM
ISN 0027              F0=SQRT(F0)*3600.*TIME
ISN 0028              FP=SQRT(FP)*3600.*TIME
ISN 0029              IF(IFIN.EQ.0) WRITE(6,15)F0,FP
ISN 0031           15 FORMAT(//6X,'NO =',E15.7,10X,'NP =',E15.7//)
ISN 0032              R1=F0/FP
ISN 0033              K1=SQRT(1.0-R1**2)
ISN 0034              K2=K1/R1
ISN 0035              ND=NDZ+1
ISN 0036              DO 20 I=1,ND
ISN 0037              DO 20 J=1,2
ISN 0038              IF( IFIN.EQ.0 ) GO TO 21
ISN 0040              XN=(((I-1)*DZ)**(1.0/R)+(-1)**J*MEAN)/SQRT(VAR)
ISN 0041              GO TO 23
```

```
ISN 0042      21   XN=(I-1)*DZ/SQRT(VAR)
ISN 0043      23   X1=XN/K1
ISN 0044           IF( X1.LT.6.0 ) GO TO 22
ISN 0046           PL(I,J)=0.
ISN 0047           GO TO 20
ISN 0048      22   CALL NDTR(X1,P1,D1)
ISN 0049           X2=XN/K2
ISN 0050           CALL NDTR(X2,P2,D2)
ISN 0051           P1=1.0-P1
ISN 0052           P2=1.0-P2
ISN 0053           PL(I,J)=FP*(P1+R1*(1.0-P2)/EXP(XN**2/2.))
ISN 0054      20   CONTINUE
ISN 0055           RETURN
ISN 0056           END
```

```
LEVEL 21.7 ( JAN 73 )                                   OS/360  FORTRAN H

         COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=55,SIZE=0000K,
                              SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,NOXREF
  ISN 0002            SUBROUTINE FILTER(A,NPK,PMIN,PMAX,NPKR)
                C
                C SUBROUTINE FLILTER APPLIES THE RISE AND FALL CRITERION TO THE
                C LIST OF PEAKS AND VALLEYS...
                C
  ISN 0003            DIMENSION A(NPK)
  ISN 0004            KV=2
  ISN 0005            KP=4
  ISN 0006            NV=6
  ISN 0007            NP=8
  ISN 0008            IF(A(2).LT.A(4)) GO TO 500
  ISN 0010            KP=2
  ISN 0011            KV=4
  ISN 0012            NP=6
  ISN 0013            NV=8
                C
  ISN 0014        400 CONTINUE
                C
                C          WE NOW END WITH A VALLEY AND ARE SEARCHING FOR THE NEXT PEAK
                C
                C          HAVE WE USED UP THE A ARRAY
  ISN 0015            IF(NV.GT.NPK) GO TO 600
  ISN 0017            PR=PMAX
                C
                C     DOES THE NEXT RISE HAVE TO BE PMAX, OR IS PMIN ENOUGH
                C
  ISN 0018            IF((A(KP)-A(KV)-PMAX).GE.0.) PR=PMIN
                C
                C          IS THE NEXT PEAK LARGE ENOUGH TO COUNT
                C                                  NO  YES  YES
  ISN 0020            IF(A(NP)-A(KV)-PR) 405,430,430
                C
  ISN 0021        405 CONTINUE
                C
                C          NOT ENOUGH RISE
                C
                C          BUT IS IT LARGER THAN CURRENT PEAK
                C                               NO  NO  YES
  ISN 0022            IF (A(NP)-A(KP)) 415,415,410
  ISN 0023        410 CONTINUE
                C
                C     REPLACE CURRENT PEAK
  ISN 0024            A(KP)=A(NP)
  ISN 0025            A(KP-1)=A(NP-1)
  ISN 0026            NP=NP+4
                C          THROW AWAY CURRENT VALLEY
  ISN 0027            KV=KV-4
                C          WAS IT THE FIRST VALLEY
  ISN 0028            IF(KV.NE.0) GO TO 500
  ISN 0030            A1=A(1)
  ISN 0031            A2=A(2)
```

```
ISN 0032          A(1)=A(3)
ISN 0033          A(2)=A(4)
ISN 0034          A(3)=A1
ISN 0035          A(4)=A2
ISN 0036          KV=2
ISN 0037          KP=4
ISN 0038          GO TO 500
ISN 0039      415 CONTINUE
            C
            C          IS NEXT VALLEY LOWER THAN CURRENT VALLEY
            C                         YES  NO  NO
ISN 0040          IF(A(NV)-A(KV)) 420,425,425
ISN 0041     420  CONTINUE
            C
            C          REPLACE CURRENT VALLEY
            C
ISN 0042          A(KV)=A(NV)
ISN 0043          A(KV-1)=A(NV-1)
ISN 0044          NP=NP+4
ISN 0045          NV=NV+4
ISN 0046          GO TO 400
ISN 0047      425 CONTINUE
            C
            C     KEEP LOOKING
            C
ISN 0048          NV=NV+4
ISN 0049          NP=NP+4
ISN 0050          GO TO 400
ISN 0051      430 CONTINUE
            C
            C     WE HAVE THE NEXT PEAK, NOW MOVE IT DOWN TO THE NEXT AVAILABLE
            C     LOCATION
            C
ISN 0052          A(KP+4)=A(NP)
ISN 0053          A(KP+3)=A(NP-1)
ISN 0054          KP=KP+4
ISN 0055          NP=NP+4
ISN 0056      500 CONTINUE
            C
            C          WE NOW END WITH A PEAK AND ARE LOOKING FOR THE NEXT VALLEY
            C
            C          HAVE WE USED UP THE A ARRAY
ISN 0057          IF(NP.GT.NPK) GO TO 600
ISN 0059          PR=PMAX
            C
            C          DOES THE NEXT FALL HAVE TO BE PMAX, OR IS PMIN ENOUGH
            C
ISN 0060          IF((A(KP)-A(KV)-PMAX).GE.0.) PR=PMIN
            C
            C          IS THE NEXT VALLEY LOW ENOUGH TO COUNT
            C                                NO  YES YES
ISN 0062          IF(A(KP)-A(NV)-PR) 505,530,530
ISN 0063      505 CONTINUE
```

```
                   C
                   C          NOT ENOUGH FALL
                   C
                   C          BUT IS IT LOWER THAN THE CURRENT VALLEY
                   C                        YES NO  NO
ISN 0064                IF(A(NV)-A(KV)) 510,515,515
ISN 0065            510 CONTINUE
                   C
                   C          REPLACE CURRENT VALLEY
ISN 0066                A(KV)=A(NV)
ISN 0067                A(KV-1)=A(NV-1)
ISN 0068                NV=NV+4
                   C          THROW AWAY CURRENT PEAK
ISN 0069                KP=KP-4
                   C          BUT WAS IT THE FIRST PEAK
ISN 0070                IF(KP.NE.0) GO TO 400
ISN 0072                A1=A(1)
ISN 0073                A2=A(2)
ISN 0074                A(1)=A(3)
ISN 0075                A(2)=A(4)
ISN 0076                A(3)=A1
ISN 0077                A(4)=A2
ISN 0078                KP=2
ISN 0079                KV=4
ISN 0080                GO TO 400
ISN 0081            515 CONTINUE
                   C
                   C          IS NEXT PEAK HIGHER THAN CURRENT PEAK
                   C                         NO NO  YES
ISN 0082                IF(A(NP)-A(KP)) 525,525,520
ISN 0083            520 CONTINUE
                   C
                   C        REPLACE CURRENT PEAK
                   C
ISN 0084                A(KP)=A(NP)
ISN 0085                A(KP-1)=A(NP-1)
ISN 0086                NP=NP+4
ISN 0087                NV=NV+4
ISN 0088                GO TO 500
ISN 0089            525 CONTINUE
                   C
                   C          KEEP LOOKING
                   C
ISN 0090                NV=NV+4
ISN 0091                NP=NP+4
ISN 0092                GO TO 500
ISN 0093            530 CONTINUE
                   C
                   C        WE HAVE THE NEXT VALLEY, NOW MOVE IT TO THE NEXT AVAILABLE LOATION
                   C
                   C
ISN 0094                A(KV+4)=A(NV)
ISN 0095                A(KV+3)=A(NV-1)
```

```
ISN 0096          KV=KV+4
ISN 0097          NV=NV+4
ISN 0098          GO TO 400
ISN 0099      600 CONTINUE
ISN 0100          NPKR=MAX0(KP,KV)
ISN 0101          RETURN
ISN 0102          END
```

```
LEVEL 21.7 ( JAN 73 )                              OS/360  FORTRAN H

     COMPILER OPTIONS - NAME=  MAIN,OPT=02,LINECNT=55,SIZE=0000K,
                        SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,NOXREF
ISN 0002          SUBROUTINE TLU(X,Y,NOPTS,XVAL,YVAL)
            C
            C TLU IS A LINEAR INTERPOLATION TABLE LOOK-UP SUBROUTINE...
            C
ISN 0003          DIMENSION X(1),Y(1)
ISN 0004          I=1
ISN 0005     1776 IF(X(I)-XVAL )1777,1780,1780
ISN 0006     1777 IF(X(I+1)-XVAL )1778,1781,1779
ISN 0007     1778 I=I+1
ISN 0008          IF(NOPTS-I)1782,1776,1776
ISN 0009     1779 RATIO=(XVAL -X(I))/(X(I+1)-X(I))
ISN 0010          YVAL =RATIO*(Y(I+1)-Y(I))+Y(I)
ISN 0011          GO TO 1783
ISN 0012     1780 YVAL =Y(I)
ISN 0013          GO TO 1783
ISN 0014     1781 YVAL =Y(I+1)
ISN 0015          GO TO 1783
ISN 0016     1782 I=NOPTS
ISN 0017          YVAL=(XVAL-X(I))*(Y(I)-Y(I-1))/(X(I)-X(I-1))+Y(I)
ISN 0018     1783 RETURN
ISN 0019          END
```

APPENDIX B SAMPLE PROBLEM WITH INPUT DATA LISTING

INPUT DATA

```
AIR-TO-AIR BASELINE
  15      2       7      46    759
 0.            4904.     .0022      3903.      .0044      2561.
 .0067         2240.     .0089      2138.      .0111      1817.
 .0133         1977.     .0156      3126.      .0178      3794.
 .02           3088.     .0222      2093.      .0244      1316.
 .0267         995.      .0289      1303.      .0311      1406.
 .0333         1027.     .0356      802.       .0378      757.
 .04           629.      .0422      443.       .0444      334.
 .0467         379.      .0489      488.       .0511      417.
 .0533         315.      .0556      308.       .0578      276.
 .06           244.      .0622      205.       .0644      154.
 .0667         160.      .0689      160.       .0711      160.
 .0733         160.      .0756      141.       .0778      128.
 .08           116.      .0822      109.       .0844      83.
 .0867         49.       .0889      51.        .0911      60.
 .0933         57.       .0956      47.        .0978      40.
 .1            45.
  12   5.          10.0       10.0       22.2      1.128      1
  13  10.
```

PROGRAM OUTPUT

```
M1=   15   NR=    2   NX=    7   NSPD=   46   IX=  759

 I        W(I)            PSD(I)

  1  0.0             0.4904000E+04
  2  0.2200000E-02   0.3903000E+04
  3  0.4400000E-02   0.2561000E+04
  4  0.6700002E-02   0.2240000E+04
  5  0.8900002E-02   0.2138000E+04
  6  0.1110000E-01   0.1817000E+04
  7  0.1330000E-01   0.1977000E+04
  8  0.1560000E-01   0.3126000E+04
  9  0.1780000E-01   0.3794000E+04
 10  0.2000000E-01   0.3088000E+04
 11  0.2220000E-01   0.2093000E+04
 12  0.2440000E-01   0.1316000E+04
 13  0.2670000E-01   0.9950000E+03
 14  0.2890000E-01   0.1303000E+04
 15  0.3110000E-01   0.1406000E+04
 16  0.3330000E-01   0.1027000E+04
 17  0.3560000E-01   0.8020000E+03
 18  0.3780000E-01   0.7570000E+03
 19  0.4000000E-01   0.6290000E+03
 20  0.4220000E-01   0.4430000E+03
 21  0.4440000E-01   0.3340000E+03
 22  0.4670000E-01   0.3790000E+03
 23  0.4890000E-01   0.4880000E+03
 24  0.5110000E-01   0.4170000E+03
 25  0.5330000E-01   0.3150000E+03
 26  0.5560000E-01   0.3080000E+03
 27  0.5780000E-01   0.2760000E+03
 28  0.6000000E-01   0.2440000E+03
 29  0.6220000E-01   0.2050000E+03
 30  0.6440002E-01   0.1540000E+03
 31  0.6669998E-01   0.1600000E+03
 32  0.6889999E-01   0.1600000E+03
 33  0.7110000E-01   0.1600000E+03
 34  0.7330000E-01   0.1600000E+03
 35  0.7560003E-01   0.1410000E+03
 36  0.7779998E-01   0.1280000E+03
 37  0.7999998E-01   0.1160000E+03
 38  0.8219999E-01   0.1090000E+03
 39  0.8440000E-01   0.8300000E+02
 40  0.8670002E-01   0.4900000E+02
 41  0.8890003E-01   0.5100000E+02
 42  0.9109998E-01   0.6000000E+02
 43  0.9329998E-01   0.5700000E+02
 44  0.9560001E-01   0.4700000E+02
 45  0.9780002E-01   0.4000000E+02
 46  0.1000000E+00   0.4500000E+02

   NDZ =      12         DZ =  0.5000000E+01         PMAX =      10.00         PMIN =     10.00
   MEAN =    22.200         R =       1.128          INC =    1
```

ANJZ = 13   ADZ = 10.

THE ELAPSED TIME FOR THIS RUN IS 22.755539 HOURS.

GAUSSIAN EXCEEDANCE TABLE

NO = 0.2292718E+04   NP = 0.4580586E+04

NZ RANGE		PEAKS	VALLEYS	PEAK EXCEED	VALLEY EXCEED	THEORITICAL EXCEED
0.0-	5.0	905	581	3258	1000	3436.7
5.0-	10.0	968	283	2353	419	2493.5
10.0-	15.0	728	104	1385	136	1495.9
15.0-	20.0	424	25	657	32	718.8
20.0-	25.0	166	7	233	7	271.0
25.0-	30.0	57	0	67	0	79.1
30.0-	35.0	10	0	10	0	17.8
35.0-	40.0	0	0	0	0	3.1
40.0-	45.0	0	0	0	0	0.4
45.0-	50.0	0	0	0	0	0.0
50.0-	55.0	0	0	0	0	0.0
55.0-	60.0	0	0	0	0	0.0
60.0-	65.0	0	0	0	0	0.0
0.0-	-5.0	634	883	1103	3362	3436.7
-5.0-	-10.0	330	951	469	2479	2493.5
-10.0-	-15.0	104	789	139	1528	1495.9
-15.0-	-20.0	26	452	35	739	718.8
-20.0-	-25.0	8	199	9	287	271.0
-25.0-	-30.0	1	68	1	88	79.1
-30.0-	-35.0	0	18	0	20	17.8
-35.0-	-40.0	0	2	0	2	3.1
-40.0-	-45.0	0	0	0	0	0.4
-45.0-	-50.0	0	0	0	0	0.0
-50.0-	-55.0	0	0	0	0	0.0
-55.0-	-60.0	0	0	0	0	0.0
-60.0-	-65.0	0	0	0	0	0.0

NPKR= 17446

NPKR= 17446

THE MOST CURRENT VALUE OF IX IS 297431

REAL EXCEEDANCE TABLE UNFILTERED

NZ RANGE	PEAKS	VALLEYS	PEAK EXCEED	VALLEY EXCEED	THEORITICAL EXCEED
0.0- 10.0	35	623	4356	4176	4577.6
10.0- 20.0	198	1101	4321	3553	4534.7
20.0- 30.0	607	1184	4123	2452	4318.9
30.0- 40.0	991	781	3516	1268	3712.5
40.0- 50.0	1117	349	2525	487	2672.4
50.0- 60.0	810	112	1408	138	1518.9
60.0- 70.0	410	22	598	26	659.0
70.0- 80.0	149	4	188	4	215.1
80.0- 90.0	35	0	39	0	52.6
90.0- 100.0	4	0	4	0	9.7
100.0- 110.0	0	0	0	0	1.3
110.0- 120.0	0	0	0	0	0.1
120.0- 130.0	0	0	0	0	0.0
130.0- 140.0	0	0	0	0	0.0
0.0- -10.0	5	164	5	186	162.8
-10.0- -20.0	0	20	0	22	18.4
-20.0- -30.0	0	2	0	2	1.8
-30.0- -40.0	0	0	0	0	0.1
-40.0- -50.0	0	0	0	0	0.0
-50.0- -60.0	0	0	0	0	0.0
-60.0- -70.0	0	0	0	0	0.0
-70.0- -80.0	0	0	0	0	0.0
-80.0- -90.0	0	0	0	0	0.0
-90.0--100.0	0	0	0	0	0.0
-100.0--110.0	0	0	0	0	0.0
-110.0--120.0	0	0	0	0	0.0
-120.0--130.0	0	0	0	0	0.0
-130.0--140.0	0	0	0	0	0.0

NPKR= 17446

THE MOST CURRENT VALUE OF IX IS 297431

REAL EXCEEDANCE TABLE FILTERED

NZ RANGE	PEAKS	VALLEYS	PEAK EXCEED	VALLEY EXCEED	THEORITICAL EXCEED
0.0- 10.0	1	553	2513	2336	4577.6
10.0- 20.0	22	788	2512	1783	4534.7
20.0- 30.0	141	634	2490	995	4318.9
30.0- 40.0	409	276	2349	361	3712.5
40.0- 50.0	751	74	1940	85	2672.4
50.0- 60.0	639	10	1189	11	1518.9
60.0- 70.0	369	1	550	1	659.0
70.0- 80.0	143	0	181	0	215.1
80.0- 90.0	34	0	38	0	52.6
90.0- 100.0	4	0	4	0	9.7
100.0- 110.0	0	0	0	0	1.3
110.0- 120.0	0	0	0	0	0.1
120.0- 130.0	0	0	0	0	0.0
130.0- 140.0	0	0	0	0	0.0
0.0- -10.0	1	156	1	178	162.8
-10.0- -20.0	0	20	0	22	18.4
-20.0- -30.0	0	2	0	2	1.8
-30.0- -40.0	0	0	0	0	0.1
-40.0- -50.0	0	0	0	0	0.0
-50.0- -60.0	0	0	0	0	0.0
-60.0- -70.0	0	0	0	0	0.0
-70.0- -80.0	0	0	0	0	0.0
-80.0- -90.0	0	0	0	0	0.0
-90.0--100.0	0	0	0	0	0.0
-100.0--110.0	0	0	0	0	0.0
-110.0--120.0	0	0	0	0	0.0
-120.0--130.0	0	0	0	0	0.0
-130.0--140.0	0	0	0	0	0.0

NPKR= 10056

LIST OF FILTERED PEAKS AND VALLEYS

25.0	60.9	16.1	54.1	20.1	45.5	25.0	52.3	36.0	58.7
28.2	44.5	18.6	48.6	24.5	81.9	8.6	29.4	17.8	52.4
17.5	29.5	10.2	79.9	18.8	50.6	32.5	53.7	17.3	65.7
50.6	63.5	3.1	67.5	10.9	60.6	44.0	54.9	16.2	45.1
14.7	34.0	20.4	58.4	31.2	45.6	27.8	63.5	9.4	69.7
36.1	58.2	-2.0	79.4	27.6	42.9	27.9	41.0	9.4	33.5
16.0	40.2	5.2	39.1	19.5	51.9	9.3	31.4	19.1	48.6
0.4	27.6	16.9	36.2	11.8	28.7	9.3	33.2	1.8	13.2
1.4	50.2	18.6	31.8	19.1	48.8	34.0	63.7	29.9	86.8
22.5	42.7	12.2	40.8	22.0	41.9	21.2	42.2	16.3	26.6
-3.6	27.3	11.9	45.3	34.7	48.8	14.7	48.6	23.6	57.2
36.4	58.3	32.7	48.7	27.1	41.5	29.7	81.1	29.3	60.7
19.8	43.5	28.5	74.9	19.2	48.5	22.4	38.3	5.1	52.8
34.0	45.0	14.7	46.4	3.0	34.8	19.8	48.7	33.4	54.2
25.4	38.7	18.3	36.0	18.5	63.7	17.7	56.1	11.7	29.3
-7.5	41.4	15.3	33.8	9.7	36.1	7.2	61.7	16.3	50.9
30.1	47.9	25.4	52.1	24.9	65.2	-10.3	50.7	12.6	44.6
32.1	47.0	24.3	38.4	19.6	46.2	23.4	42.3	3.5	52.9
35.8	64.4	16.9	30.6	19.1	47.2	6.4	74.1	12.2	50.2
28.8	45.6	12.7	46.2	15.3	39.2	20.2	46.4	36.3	58.6
3.8	60.0	11.9	44.6	29.5	41.3	11.5	40.4	27.4	47.4
6.9	44.3	32.4	58.2	16.3	55.1	-4.6	83.3	0.6	37.5
24.1	57.7	16.2	34.8	22.2	65.7	24.8	47.5	13.4	55.9
42.5	64.5	24.9	38.5	-22.0	61.8	36.2	66.4	39.4	60.9
35.4	56.8	25.5	51.2	34.5	54.9	26.8	39.5	-3.7	81.0
-1.8	47.0	12.5	59.6	8.3	53.9	7.7	45.3	29.7	66.4
12.4	49.2	5.5	33.5	15.0	36.1	2.7	58.5	2.8	40.9
13.8	38.1	13.2	51.7	4.0	33.3	9.4	29.3	11.6	68.5
19.0	45.4	30.9	45.9	13.5	48.1	21.1	57.3	13.9	35.2
18.7	37.3	19.3	40.6	1.1	25.6	8.3	67.1	32.8	71.0
21.5	51.4	12.5	42.8	11.3	41.4	22.8	47.5	17.9	48.9
17.5	55.1	11.9	41.4	12.2	79.3	15.1	50.4	28.7	45.8
34.3	59.1	28.3	45.5	29.1	52.9	12.0	65.1	30.9	48.0
9.2	66.8	47.6	61.6	15.0	31.1	14.3	50.6	7.7	53.2
39.7	68.1	6.8	20.5	6.2	56.5	9.3	75.7	12.6	52.7
31.3	55.7	17.4	57.7	22.3	61.7	29.0	51.7	39.8	55.5
12.2	42.6	8.1	25.8	14.9	60.0	13.5	56.0	14.8	63.7
21.6	32.8	20.3	43.4	9.7	48.1	33.5	45.2	-7.3	47.1
8.4	77.9	45.9	58.8	10.3	71.8	10.6	38.2	23.3	46.2
-9.8	40.3	4.9	41.1	17.9	42.7	5.1	41.8	27.2	58.7
29.8	42.9	13.3	46.0	1.2	26.5	-4.5	51.3	5.4	26.6
15.4	38.3	8.6	39.0	5.3	60.3	-7.0	42.2	13.0	34.4
15.8	55.6	12.7	40.8	23.6	49.4	36.7	53.9	25.7	41.0
18.2	33.3	22.5	46.5	3.0	44.7	6.4	39.8	22.5	64.3
24.5	57.0	26.3	53.4	9.8	33.3	0.9	46.4	0.3	48.9
24.5	47.4	22.3	47.2	6.3	77.9	25.9	74.7	18.7	64.1
22.7	58.6	4.7	72.1	7.6	72.3	17.5	53.0	27.0	59.3
15.0	42.4	27.8	41.6	17.3	70.0	12.9	47.5	25.4	66.3
50.3	89.9	-0.2	69.5	47.1	60.2	13.1	66.1	11.6	71.4
18.7	53.3	18.2	35.5	10.7	42.3	5.6	61.4	23.5	49.3
19.1	51.0	1.3	45.7	15.9	32.5	20.9	43.4	28.9	47.3
22.5	46.1	21.8	52.4	36.4	61.3	8.7	57.5	38.5	54.9
25.6	39.9	28.4	50.2	8.9	31.0	13.8	55.9	42.8	75.9
16.6	50.3	34.6	46.2	11.4	66.4	11.7	55.5	-6.0	50.9

37.6	51.0	22.5	37.5	14.6	24.7	1.2	33.1	6.7	26.8
1.5	42.0	0.5	41.0	11.2	47.8	19.5	37.6	9.6	49.7
-0.4	40.1	29.0	44.2	23.4	60.8	14.2	40.4	23.3	45.3
24.3	56.8	28.2	67.6	22.8	66.6	32.9	52.2	29.9	56.5
28.3	58.5	25.0	55.9	38.0	60.4	23.8	68.7	24.0	61.6
18.6	65.3	21.5	49.1	6.8	30.4	1.0	58.5	17.4	29.3
8.8	42.3	31.6	49.6	34.8	48.4	25.7	46.8	16.8	41.3
-0.7	61.2	8.6	42.7	5.1	44.9	16.0	59.0	-0.7	64.7
21.5	55.4	17.6	36.6	21.0	36.9	7.5	55.0	29.8	51.4
2.2	72.7	1.3	32.2	-3.8	70.1	8.8	73.8	21.9	49.6
38.6	54.0	41.3	56.3	27.5	38.1	25.3	49.5	9.6	60.9
13.9	53.4	14.9	36.7	15.9	41.8	15.3	38.3	19.8	58.7
28.7	46.8	19.0	55.2	8.9	49.2	5.9	49.6	19.9	55.6
-0.1	21.5	-8.9	27.4	12.2	51.4	21.6	59.9	16.8	78.8
-2.5	40.2	3.7	80.9	7.5	62.3	31.2	60.0	37.3	54.7
28.2	42.3	30.5	57.2	13.4	26.6	9.6	29.9	12.5	23.8
-0.7	55.7	-4.2	37.7	18.1	56.9	36.3	56.8	27.5	41.8
-0.6	47.0	23.3	62.3	10.0	50.8	30.6	50.0	15.0	37.6
20.2	37.6	21.7	53.2	37.1	65.4	18.7	57.7	4.8	37.8
24.6	42.7	1.6	40.1	13.4	62.1	4.4	52.7	2.6	68.3
6.2	34.7	-0.9	38.9	24.2	59.2	2.4	47.6	12.3	36.2
9.1	52.4	2.4	16.6	-5.1	56.3	35.8	53.2	1.7	52.1
35.6	70.2	28.3	40.0	25.2	49.2	20.9	35.2	17.6	37.4
26.4	53.7	20.7	34.3	8.1	45.5	34.6	48.7	23.9	88.7
1.9	82.4	21.1	54.4	30.2	60.1	5.8	35.7	14.5	60.4
23.2	48.4	19.9	49.7	5.5	68.3	42.8	54.9	24.5	48.8
23.6	42.7	5.8	43.6	26.0	74.2	12.6	34.2	23.3	37.5
24.9	36.9	26.5	55.5	22.5	66.8	52.5	65.0	23.9	56.2
10.7	61.0	27.4	53.4	13.3	37.9	20.5	33.2	22.3	40.3
25.7	62.8	39.8	53.4	21.5	67.9	24.8	48.5	6.9	31.1
18.1	41.4	14.8	27.1	10.4	61.2	8.5	53.4	3.1	27.7
15.0	44.5	14.9	66.4	35.8	59.1	30.2	71.3	24.0	76.1
28.3	52.1	14.8	69.1	40.5	73.0	8.4	56.3	22.9	37.7
17.2	60.1	6.2	36.5	16.9	57.2	10.1	42.2	21.2	67.9
5.3	63.4	34.3	47.4	19.4	52.9	21.4	57.5	17.5	38.7
10.0	56.2	26.1	45.5	27.9	60.4	25.5	41.8	19.7	56.5
24.9	37.0	24.6	47.5	17.2	92.5	5.3	44.1	5.4	20.5
-0.3	37.7	26.0	39.8	3.3	23.9	3.2	42.6	-1.9	57.6
42.5	62.9	19.4	74.2	13.4	46.8	23.2	52.5	26.4	37.2
9.1	35.9	22.0	69.2	32.4	54.8	35.2	54.0	14.5	53.6
12.8	38.9	21.4	53.7	28.6	49.5	39.2	60.8	26.1	52.9
6.7	61.4	21.5	43.1	19.7	31.6	4.8	24.1	-11.9	47.8
14.6	34.3	10.4	35.8	10.2	21.6	9.0	41.6	12.7	51.6
10.1	36.5	16.7	54.3	35.0	73.8	34.4	71.1	38.3	52.0
20.9	58.5	28.7	48.7	24.9	44.6	28.0	48.0	35.3	62.3
45.4	74.7	33.8	46.3	21.4	53.4	8.9	45.9	-3.5	48.8
15.6	58.4	32.2	48.8	9.6	48.7	15.3	26.4	3.0	57.5
15.4	31.7	15.3	41.5	7.9	27.7	14.7	71.6	6.4	24.7
3.0	54.2	-0.8	46.7	11.5	34.2	-2.9	32.1	-0.3	47.9
3.1	31.1	9.6	55.2	5.7	50.7	27.8	38.6	9.6	63.1
29.6	49.0	31.0	61.7	43.5	65.7	6.3	47.8	23.1	71.9
10.0	76.6	22.7	38.0	5.2	31.1	17.5	70.8	35.3	61.6
26.8	56.5	7.2	54.9	17.4	30.1	9.2	19.9	5.9	17.9
6.2	65.2	-1.9	76.0	5.9	55.9	13.8	63.4	37.4	59.9
33.4	45.6	23.8	50.1	21.7	54.7	12.2	46.3	32.0	44.1
6.6	70.8	-5.5	48.4	23.9	45.7	20.3	52.5	6.2	35.3
20.3	61.8	8.1	47.5	28.7	41.5	16.8	34.2	6.3	84.1
25.8	47.9	30.3	59.6	20.5	64.6	38.3	55.0	27.8	43.2
26.0	62.8	17.1	40.1	17.6	30.6	12.8	65.8	9.5	59.6
34.4	67.6	-4.2	60.6	0.9	63.5	12.8	37.9	7.7	69.5
10.7	42.4	25.9	42.3	7.8	54.1	34.7	66.4	23.2	49.9
12.4	34.5	23.5	50.5	25.5	44.1	22.4	45.7	26.1	74.2
39.4	61.1	28.2	45.7	18.3	53.7	20.6	54.1	32.1	67.6
23.4	62.3	28.4	80.2	19.1	48.7	29.4	55.9	19.7	79.2
11.2	43.8	21.7	48.2	20.9	71.9	33.9	63.3	34.9	52.7
29.8	60.6	10.7	65.8	17.5	64.9	11.1	41.7	11.5	34.0
-22.0	26.3	11.0	30.7	19.0	40.1	29.5	47.3	2.7	60.1
26.0	59.6	28.2	64.9	21.9	52.8	34.7	45.6	27.3	53.8

30.2	57.5	23.3	62.3	3.2	46.9	11.1	35.2	16.7	35.3
7.1	45.9	15.4	46.9	22.0	50.0	24.0	36.6	13.8	52.0
4.1	17.7	-4.2	36.9	6.0	36.1	5.3	59.4	19.0	67.1
19.0	48.0	19.8	78.5	21.8	45.9	21.9	45.8	9.5	67.8
17.8	37.8	18.5	85.2	24.5	35.3	20.3	56.2	31.6	62.8
8.7	50.2	10.5	65.9	20.0	42.3	5.2	34.2	1.9	55.6
21.4	64.7	-0.1	10.4	-3.7	62.3	6.6	44.3	[illegible]	41.6
24.3	39.6	19.4	31.1	15.8	32.8	-0.2	48.3	15.5	45.0
0.4	41.0	16.2	45.2	34.1	58.6	26.5	48.4	10.5	39.9
9.8	61.8	5.4	53.0	26.9	44.4	2.1	57.4	28.3	49.5
18.3	56.5	-2.9	49.3	36.9	68.0	49.3	74.5	34.2	44.8
21.6	54.1	12.5	52.3	12.8	46.1	29.1	71.4	34.0	69.0
30.4	42.4	14.7	39.9	6.6	27.4	1.9	77.7	27.1	53.9
16.3	70.1	22.6	67.1	43.0	63.1	7.7	27.8	[illegible]	46.0
8.8	54.7	25.8	53.5	22.6	48.9	33.4	47.8	35.8	74.6
43.2	53.3	21.5	69.1	21.7	83.9	10.9	43.6	18.2	34.3
7.6	45.9	32.7	54.3	9.3	50.3	2.6	35.7	16.2	43.3
29.9	52.5	13.8	58.6	16.2	63.0	32.5	49.1	[illegible]	[illegible]
16.4	57.4	-0.1	65.3	49.2	65.3	7.8	53.0	27.7	[illegible]
33.7	65.3	15.4	31.6	5.5	22.3	12.8	45.7	[illegible]	[illegible]
2.1	68.4	7.4	63.3	10.5	22.8	25.9	58.0	[illegible]	[illegible]
8.0	56.9	7.5	38.5	1.7	41.7	29.5	61.8	[illegible]	[illegible]
25.1	51.8	20.6	58.3	42.7	63.2	22.8	[illegible]	20.0	[illegible]
28.4	54.7	-3.6	46.2	14.0	46.8	21.4	18.8	12.4	[illegible]
-5.8	39.7	4.5	64.8	1.8	41.9	20.6	[illegible]	[illegible]	[illegible]
9.1	40.2	13.5	51.5	20.2	54.5	24.5	59.8	[illegible]	[illegible]
5.6	24.8	22.7	38.4	28.8	43.9	12.6	29.3	[illegible]	[illegible]
30.4	45.0	10.4	75.9	30.0	49.8	15.4	[illegible]	[illegible]	[illegible]
3.5	36.2	28.1	48.0	25.9	41.5	21.2	[illegible]	[illegible]	[illegible]
21.8	49.5	6.8	56.1	6.0	44.9	9.9	65.1	[illegible]	[illegible]
11.6	51.4	13.7	58.3	22.4	41.8	16.6	[illegible]	[illegible]	[illegible]
11.8	41.1	-4.2	32.6	11.7	75.6	3.5	64.5	[illegible]	[illegible]
28.8	57.7	30.9	73.3	12.5	41.9	28.5	[illegible]	[illegible]	[illegible]
14.6	41.7	22.0	67.3	28.4	71.2	12.0	49.0	[illegible]	[illegible]
14.8	47.9	0.0	66.3	15.3	47.0	19.8	[illegible]	[illegible]	[illegible]
8.5	20.4	32.2	42.3	-14.7	48.6	13.3	[illegible]	[illegible]	[illegible]
27.6	55.3	19.7	66.8	2.6	43.4	12.6	[illegible]	[illegible]	[illegible]
0.4	43.8	9.1	56.0	8.5	20.8	-20.2	[illegible]	[illegible]	[illegible]
15.9	41.4	27.2	47.3	18.3	29.4	46.5	66.8	[illegible]	[illegible]
29.6	61.3	33.9	46.6	19.0	35.3	16.5	55.4	[illegible]	[illegible]
7.2	48.1	15.9	50.8	23.6	[illegible]	23.8	[illegible]	[illegible]	[illegible]
43.0	58.3	14.5	52.5	29.6	[illegible]	10.2	[illegible]	[illegible]	[illegible]
27.9	52.8	2.0	44.2	16.6	[illegible]	25.0	60.0	[illegible]	[illegible]
21.1	41.8	14.4	62.0	23.0	[illegible]	10.1	[illegible]	[illegible]	[illegible]
33.7	47.5	9.9	54.5	23.8	[illegible]	14.8	[illegible]	[illegible]	[illegible]
6.8	26.9	8.0	63.4	31.0	[illegible]	20.2	[illegible]	[illegible]	[illegible]
28.2	40.6	22.6	43.9	11.6	[illegible]	16.1	[illegible]	[illegible]	[illegible]
27.6	40.2	31.2	67.4	10.2	[illegible]	21.4	[illegible]	[illegible]	[illegible]
28.1	45.1	16.9	45.3	-6.0	58.4	8.0	[illegible]	[illegible]	[illegible]
10.3	56.6	1.5	34.8	1.2	54.6	24.0	[illegible]	[illegible]	[illegible]
7.9	49.4	2.1	48.3	15.0	[illegible]	20.3	[illegible]	[illegible]	[illegible]
6.9	50.6	11.9	49.0	13.2	[illegible]	28.6	[illegible]	[illegible]	[illegible]
21.9	42.9	15.7	56.9	18.6	[illegible]	10.2	[illegible]	[illegible]	[illegible]
-10.8	67.3	14.6	43.4	32.6	[illegible]	44.4	[illegible]	[illegible]	[illegible]
30.8	48.6	21.3	77.3	29.9	[illegible]	18.5	[illegible]	[illegible]	[illegible]
1.3	59.0	34.0	64.6	3.3	[illegible]	19.8	[illegible]	[illegible]	[illegible]
5.4	55.0	8.6	50.6	1.9	[illegible]	14.0	[illegible]	[illegible]	[illegible]
11.1	46.1	24.3	47.3	15.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
32.6	65.4	37.0	64.4	16.9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
27.3	58.1	32.0	27.6	15.7	30.8	[illegible]	[illegible]	[illegible]	[illegible]
36.0	50.8	14.5	56.3	3.6	48.5	[illegible]	[illegible]	[illegible]	[illegible]
0.0	49.8	8.0	42.0	1.6	38.2	[illegible]	[illegible]	[illegible]	[illegible]
38.8	54.4	22.7	67.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18.2	34.0	23.0	49.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13.3	49.0	17.7	60.6	[illegible]	35.8	[illegible]	[illegible]	19.0	[illegible]
6.1	45.2	15.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	30.0	[illegible]
29.1	46.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13.6	35.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

9.8	19.9	7.2	44.2	22.7	33.6	11.6	40.9	4.8	67.1
16.2	74.6	10.0	23.2	1.0	21.3	1.9	73.9	1.8	42.2
30.1	61.6	13.6	39.7	15.7	50.3	32.4	70.4	20.6	66.0
25.8	56.5	42.0	55.6	10.9	48.5	17.1	37.8	3.4	32.5
4.2	41.9	16.4	46.9	11.8	46.7	20.5	52.1	1.7	52.4
35.4	49.1	24.7	70.4	18.8	64.8	-1.8	49.5	9.3	23.9
12.0	48.2	22.9	37.3	10.8	31.5	16.8	40.2	20.3	48.5
26.7	59.9	21.7	52.3	11.1	35.8	20.9	49.2	5.4	25.2
12.6	47.9	25.5	41.9	3.4	57.8	28.0	39.6	-0.2	31.0
7.8	37.0	8.3	37.0	13.0	67.2	5.6	45.6	8.9	33.7
4.4	67.4	15.9	46.6	36.1	46.6	18.3	59.3	38.2	64.7
13.5	39.2	16.4	49.9	12.1	54.3	20.9	42.1	17.3	43.1
11.5	51.2	19.2	39.1	12.0	44.9	23.4	34.3	-13.2	61.3
9.0	48.7	8.8	39.1	24.4	42.4	15.5	45.8	21.5	35.9
24.8	38.5	13.4	47.2	20.6	52.2	17.6	53.4	35.2	53.7
19.6	38.5	22.5	67.3	8.2	38.0	25.5	44.1	30.3	42.3
23.4	46.6	35.0	68.8	40.8	52.6	13.5	32.7	12.0	60.7
32.0	49.7	33.7	46.6	27.7	49.5	38.1	55.1	-2.3	44.9
26.3	41.7	22.2	47.1	33.8	55.4	10.8	49.0	38.4	49.8
9.8	56.9	27.4	53.7	31.9	60.6	8.0	51.0	26.1	61.8
39.6	77.7	34.8	53.2	22.6	34.4	9.2	35.0	20.2	42.3
15.6	41.5	18.8	45.7	34.1	45.0	26.0	47.5	26.0	44.1
21.6	33.2	20.2	37.6	13.5	39.3	23.0	48.7	7.5	33.7
22.6	43.5	25.6	44.7	16.3	64.5	7.8	55.8	8.2	30.6
20.2	44.8	34.1	54.0	20.7	41.1	26.6	72.3	25.5	55.5
30.0	72.5	7.3	38.1	25.1	39.0	17.6	62.8	8.2	35.2
-4.4	19.3	0.8	53.2	8.3	50.2	5.7	63.9	5.0	49.7
27.7	38.3	-1.0	27.3	2.3	55.9	16.5	59.5	26.0	50.6
9.5	41.5	6.8	39.0	18.1	32.2	16.0	50.9	35.2	56.7
-2.4	52.7	8.3	26.1	12.8	32.6	15.1	60.6	6.6	62.7
-1.8	43.9	14.7	50.2	33.8	56.7	24.2	56.9	3.3	53.8
41.4	69.1	31.5	41.7	23.0	48.9	38.5	78.3	10.6	37.5
23.0	55.0	31.9	48.0	9.9	35.6	15.7	65.1	35.2	51.4
11.2	45.0	33.1	46.8	23.9	53.5	35.1	58.2	-3.1	82.8
13.1	72.2	19.6	76.3	36.8	68.3	17.9	68.6	0.7	64.9
35.0	67.2	17.1	35.1	6.8	29.4	12.4	45.8	15.1	43.2
2.7	40.8	9.7	50.0	20.4	46.0	23.2	50.5	15.4	83.0
17.4	30.2	19.6	38.4	26.5	77.5	19.8	52.2	10.0	83.5
6.3	79.2	16.0	29.4	4.1	48.5	31.2	50.6	25.3	52.4
9.9	40.1	10.5	24.4	13.1	39.5	23.7	53.5	7.6	74.8
16.7	68.6	4.8	49.5	28.1	45.7	25.9	47.0	13.1	54.8
24.4	56.8	27.4	49.7	34.2	65.5	17.2	69.9	-8.2	30.7
11.8	51.1	31.7	48.1	19.2	29.3	18.8	65.6	23.8	68.8
56.2	74.6	38.4	56.8	28.1	54.3	31.5	59.4	45.9	61.3
30.0	57.0	36.9	71.7	34.1	67.1	43.7	61.0	28.7	47.3
33.4	66.3	30.3	43.7	21.8	47.6	14.4	43.6	-6.8	55.2
2.5	37.8	19.4	46.3	9.8	63.4	-12.7	5.0	-5.2	39.6
12.1	30.3	17.4	53.8	21.6	55.5	17.7	45.1	16.8	54.3
3.8	53.0	12.7	38.0	21.6	50.1	33.6	66.7	17.5	35.4
25.0	44.8	25.8	40.6	29.8	47.3	11.3	40.7	23.7	60.7
3.9	43.4	19.9	50.6	5.7	51.8	-1.3	55.1	17.0	82.5
34.2	61.6	40.6	54.5	14.1	60.9	14.2	50.4	19.4	62.3
2.9	79.2	41.9	53.9	11.6	28.1	13.2	26.9	8.2	50.6
7.9	49.3	4.5	19.9	-10.2	43.7	29.5	40.3	13.6	41.3
15.3	47.4	12.3	71.6	40.4	50.6	24.0	51.6	32.9	44.4
17.2	55.1	13.3	37.0	15.0	39.3	1.3	27.7	7.3	36.7
7.6	41.3	30.3	47.2	26.2	41.0	4.7	61.4	18.3	35.5
23.3	33.4	10.2	43.5	27.0	51.8	16.3	26.9	11.7	69.1
0.6	59.4	-2.9	56.6	-1.1	45.4	34.8	53.7	22.4	40.4
23.4	55.2	44.5	60.2	21.6	70.9	16.0	56.3	18.4	61.4
28.2	41.1	20.6	58.0	37.0	49.1	13.4	45.5	-0.6	59.0
7.5	64.9	17.6	53.6	39.1	63.7	14.1	51.0	-0.6	39.2
15.9	61.8	16.8	60.2	24.8	52.2	26.5	57.3	9.5	21.4
4.3	55.0	2.9	49.4	16.5	41.8	10.1	47.6	33.7	67.7
9.4	53.3	32.4	47.5	11.9	74.1	25.2	59.0	11.1	54.6
18.7	52.7	12.7	28.1	17.1	41.8	8.5	44.7	30.1	49.6
0.5	48.1	29.0	40.5	21.4	35.5	13.4	38.2	10.0	57.7
16.6	35.8	23.9	42.0	26.4	52.8	23.8	36.5	-5.6	55.1

14.3	43.4	30.1	49.8	23.4	56.1	18.4	44.6	7.8	51.0
35.9	59.7	37.2	51.7	33.6	47.7	37.0	59.2	32.5	54.9
35.0	54.5	23.7	40.1	26.9	65.3	33.1	46.6	20.0	37.3
13.8	66.6	46.9	58.4	38.5	71.3	12.8	24.8	2.7	33.1
17.6	54.6	41.1	53.2	4.4	45.7	10.9	32.9	18.7	31.0
11.8	46.6	22.2	61.5	37.9	62.7	2.3	58.1	12.8	51.8
4.5	52.0	5.2	18.5	2.0	48.9	20.4	33.5	4.0	39.3
24.5	38.9	14.5	46.6	10.9	70.0	18.5	51.8	7.8	60.5
1.1	54.5	1.4	47.4	20.9	45.7	21.4	41.1	7.2	49.2
14.4	37.6	11.9	46.6	32.0	56.0	12.7	52.7	22.1	39.0
10.7	46.1	35.8	47.9	29.0	43.5	18.3	50.6	23.5	54.1
43.2	67.0	45.5	59.1	19.3	39.2	13.5	48.6	34.9	64.3
3.7	14.7	0.8	54.7	19.5	44.7	25.3	62.8	42.2	72.6
14.1	33.1	14.8	48.7	31.1	43.4	30.3	65.7	35.8	74.1
49.6	69.8	30.1	57.6	-1.3	26.3	11.0	29.3	18.3	64.3
21.1	53.5	6.7	67.2	11.5	26.3	14.5	44.4	33.9	50.1
10.7	46.7	16.5	37.6	24.8	50.0	27.4	38.8	7.7	57.9
28.6	60.8	31.8	74.0	27.2	70.8	29.3	76.1	49.5	67.0
38.6	50.4	25.1	73.0	19.5	45.6	11.7	50.8	14.4	31.2
15.1	38.3	11.6	43.7	25.2	44.7	13.9	37.1	-2.8	29.8
10.5	27.1	10.9	51.6	21.9	61.6	46.2	56.3	39.7	49.9
15.4	46.5	31.5	50.3	18.4	44.6	18.7	61.5	15.8	65.9
48.9	59.9	15.9	31.2	17.6	68.2	-0.0	42.7	27.6	39.1
28.3	41.2	3.7	46.4	21.8	68.2	49.9	60.8	8.1	74.0
-11.2	58.5	40.6	67.0	21.9	46.7	24.3	35.7	20.0	40.7
11.8	38.2	17.3	35.8	20.4	37.2	22.7	50.4	19.7	78.0
-4.6	62.6	-4.4	37.1	1.7	53.2	32.2	44.6	20.2	30.5
13.0	56.0	22.1	33.4	20.4	77.0	22.0	47.6	29.3	41.6
10.2	36.1	23.0	40.7	21.8	54.6	-3.8	31.5	0.0	17.5
4.7	43.1	-2.0	32.3	19.8	33.7	14.4	58.8	15.1	56.3
9.9	40.9	18.0	43.1	8.9	31.6	16.4	65.4	53.5	65.3
6.8	49.3	25.5	41.3	14.6	56.8	32.0	65.6	11.5	82.0
15.2	51.7	31.1	44.3	11.4	42.9	7.0	64.1	26.6	50.5
27.8	41.1	17.4	55.3	26.4	40.1	13.3	50.0	18.0	49.5
16.4	28.1	16.2	52.5	-2.9	54.5	41.8	54.1	23.4	48.6
25.1	42.8	24.8	40.4	11.3	48.2	29.4	43.6	14.9	55.7
28.5	58.1	28.8	51.6	7.6	68.9	13.6	35.0	14.2	51.4
23.4	51.4	10.1	29.8	13.0	56.0	34.5	55.5	3.1	41.8
4.8	29.2	18.9	57.9	15.8	66.6	23.0	47.5	27.9	44.8
30.9	46.3	19.4	66.7	15.9	47.4	25.1	41.6	12.0	55.6
20.9	32.3	17.4	44.3	17.5	33.1	2.4	55.5	17.6	40.5
15.9	43.9	14.4	57.9	-1.9	37.8	19.9	53.1	17.1	63.7
33.6	44.1	16.1	31.5	19.0	55.7	23.6	57.5	-0.1	41.5
20.7	63.0	6.6	51.0	17.1	48.0	6.3	40.4	25.6	48.0
24.1	40.1	26.3	45.8	18.5	58.0	26.8	71.7	0.8	59.8
40.9	64.4	35.2	51.9	17.0	43.6	7.9	51.1	8.8	64.2
29.5	54.4	31.7	45.8	35.4	54.1	35.8	47.4	-5.1	42.7
12.7	64.5	27.3	41.3	21.3	37.5	26.4	60.0	31.0	50.3
9.4	36.7	26.5	53.5	9.7	48.3	15.4	41.8	18.8	67.6
24.6	43.6	30.2	48.8	10.1	51.0	7.4	57.5	16.9	46.2
32.9	50.2	-0.6	60.3	16.1	58.7	16.2	46.6	15.2	38.7
17.0	49.1	8.3	28.6	2.6	54.7	-9.9	55.0	36.9	49.8
7.4	54.8	-10.1	42.5	1.4	37.6	6.2	60.0	42.1	56.9
23.2	48.5	23.2	58.1	3.7	42.7	26.4	55.1	41.1	93.4
19.8	52.5	2.3	68.8	22.7	42.5	4.3	68.2	0.7	51.6
15.2	71.9	44.4	58.8	16.7	55.0	26.5	54.0	3.5	43.6
26.2	42.9	11.6	66.2	10.2	75.0	13.4	44.2	28.6	40.7
18.6	59.2	35.9	52.2	13.3	28.0	10.8	27.5	12.1	32.6
2.3	49.1	2.9	63.2	40.0	71.0	30.7	58.8	17.5	32.7
-5.5	53.1	24.9	37.5	4.9	93.7	6.5	61.4	22.7	48.2
24.7	38.0	11.9	45.1	22.4	35.8	18.1	29.9	11.8	33.4
14.3	38.3	8.9	34.7	0.6	45.4	19.4	58.2	1.1	29.7
-3.1	47.3	22.2	42.5	14.4	37.8	8.2	49.4	31.5	49.6
25.0	46.3	14.5	65.5	12.6	23.7	11.8	30.9	3.3	56.2
29.8	60.2	28.8	58.1	14.3	50.9	23.0	67.0	-2.5	45.3
8.8	47.4	25.7	47.1	14.7	24.9	8.3	40.7	21.1	34.8
10.1	41.5	23.6	57.8	24.1	35.2	16.5	40.8	22.2	57.9
-1.0	50.6	18.1	63.4	16.1	47.4	9.8	33.0	-12.7	76.2

44.2	59.6	21.8	60.9	20.2	71.8	14.9	47.1	9.6	36.4
9.7	55.9	40.8	64.7	18.1	48.1	3.2	54.1	31.0	56.8
29.0	39.9	26.0	40.9	29.0	41.5	15.6	64.9	43.3	61.5
38.7	61.0	-4.7	54.1	5.2	16.4	-8.3	25.1	12.8	25.7
13.7	29.9	19.3	64.6	11.7	30.5	19.6	38.9	24.1	53.6
40.3	70.5	8.5	49.7	5.7	42.6	17.3	52.4	19.6	72.7
19.1	42.6	19.8	48.5	8.4	41.7	25.0	56.6	21.5	54.3
31.1	56.9	25.1	67.3	27.8	44.9	31.3	69.9	27.0	39.4
-4.3	36.2	14.7	35.5	22.7	62.1	47.0	60.9	48.6	59.5
6.5	56.3	14.1	28.3	13.9	50.3	11.1	60.0	32.2	46.8
26.3	53.0	25.6	45.7	9.1	67.3	35.4	48.2	-2.2	54.3
37.3	48.0	27.2	57.3	7.7	47.2	-1.0	34.5	8.4	42.8
30.2	44.8	17.2	70.5	57.6	80.9	7.8	47.6	34.9	66.7
6.6	53.0	25.4	61.4	3.6	23.3	9.7	27.1	15.5	41.7
14.1	28.3	3.2	38.4	26.1	37.1	6.2	51.3	28.5	65.4
-6.6	84.8	33.5	54.8	14.2	58.7	-0.5	61.3	51.1	66.5
4.4	65.4	36.7	55.8	35.9	59.2	23.0	50.1	28.7	61.1
10.6	36.6	18.5	65.7	50.8	65.6	-12.8	74.8	41.0	71.4
6.8	52.2	26.2	36.3	4.8	31.9	19.9	49.3	13.5	35.3
13.1	24.8	10.8	34.7	10.7	36.0	24.4	49.1	20.4	86.3
21.9	35.4	5.3	72.0	-2.5	32.9	21.1	34.9	21.7	49.1
25.1	50.6	38.1	69.5	14.3	85.7	17.2	46.6	6.2	42.3
27.7	43.0	1.7	57.6	11.0	46.2	11.0	29.7	12.1	37.8
15.9	30.6	15.2	28.0	-3.4	55.6	4.5	34.7	18.8	42.0
-2.8	49.1	15.8	37.7	24.4	74.2	11.7	26.8	12.0	38.3
10.4	27.0	7.7	42.1	13.6	28.2	-8.3	53.5	4.0	38.5
15.9	37.5	10.2	28.5	16.0	72.9	23.1	40.1	6.7	33.4
19.6	60.5	-1.2	59.2	47.1	60.2	9.3	48.0	26.2	55.6
42.8	65.8	23.0	38.5	7.4	54.2	2.9	30.4	12.1	56.1
22.9	34.7	15.6	44.2	7.8	79.2	34.7	56.2	24.6	39.6
2.8	36.9	11.5	44.9	34.7	46.0	31.1	44.0	9.4	74.4
0.5	42.8	18.5	67.2	27.7	66.8	37.0	58.5	46.8	61.2
45.1	57.5	22.4	37.6	23.2	60.9	19.4	30.8	11.6	55.9
20.0	35.2	7.2	20.3	3.6	49.3	20.6	34.2	15.8	77.9
26.3	47.0	3.5	45.6	0.1	41.7	3.2	36.0	-3.0	40.2
23.8	47.9	8.0	50.0	23.4	37.0	0.3	36.2	-13.6	58.5
21.6	78.9	20.2	60.1	11.8	36.3	18.1	78.4	15.3	40.4
25.2	39.0	12.9	55.2	33.4	78.4	20.5	70.4	33.0	44.8
16.4	58.7	20.9	81.3	25.2	70.8	4.2	52.2	-2.9	89.4
17.6	41.8	27.4	64.8	3.3	39.9	24.7	72.4	13.7	61.8
29.3	55.2	16.8	44.0	28.8	80.2	4.1	54.5	12.4	62.7
39.1	73.6	51.7	63.9	0.7	53.9	5.4	36.5	16.3	39.1
17.1	37.6	10.1	32.5	10.9	36.4	21.9	64.9	30.2	43.0
32.0	42.8	15.2	36.8	15.1	65.7	-4.7	33.5	1.8	59.9
30.5	69.3	20.4	60.5	5.8	45.0	18.4	50.3	18.6	67.6
19.1	42.1	2.1	56.9	15.0	33.7	7.6	56.8	21.9	56.8
5.9	47.9	10.7	51.8	25.4	39.5	9.0	55.6	-8.6	49.0
10.5	26.3	3.5	39.6	9.7	25.5	13.0	46.7	11.8	59.4
23.3	51.1	9.4	50.2	-1.0	57.2	12.2	35.0	8.0	50.5
32.5	47.3	33.4	65.8	21.9	63.4	9.2	66.1	-1.5	55.6
16.6	35.7	24.8	40.3	1.8	28.7	5.0	42.5	19.4	30.4
18.6	51.2	28.1	61.0	23.3	54.1	23.4	44.2	30.1	45.2
12.9	39.8	-0.7	35.9	6.9	40.5	59.2	39.8	12.9	33.3
19.5	52.7	19.6	48.0	24.4	49.6	31.2	54.1	21.4	41.2
20.6	56.9	37.8	74.1	6.3	64.2	24.3	51.3	15.6	43.1
-6.9	61.1	17.7	29.8	0.9	46.1	14.7	25.1	0.3	22.3
-5.4	47.9	0.0	59.5	25.5	46.3	5.4	44.7	20.0	49.8
-1.1	46.0	28.2	60.7	-1.9	63.0	21.0	46.1	12.0	56.2
11.9	50.1	21.2	48.7	22.6	55.0	20.2	74.2	15.1	51.8
30.7	71.3	40.0	64.9	7.7	67.5	5.9	36.7	13.0	46.9
33.2	48.2	29.9	60.2	18.6	35.2	23.9	38.6	26.7	64.6
14.0	43.3	28.1	48.5	20.7	66.9	-10.9	24.4	5.4	43.3
14.7	57.9	29.8	43.1	-1.0	42.4	2.0	34.9	24.4	63.1
14.6	55.3	8.6	23.6	13.4	41.6	24.4	47.9	4.1	72.7
-9.0	44.4	12.7	77.4	21.3	48.1	11.8	65.4	1.6	36.2
9.4	33.7	9.0	37.9	-5.3	62.8	37.1	55.0	17.1	53.8
29.1	46.3	26.6	38.9	20.9	43.0	13.0	46.8	14.1	59.3
39.6	52.9	10.5	45.9	35.4	50.2	-0.1	34.4	2.9	65.6

1.9	31.0	12.3	50.4	-16.9	-0.1	-10.7	47.4	17.0	48.3
28.5	65.3	21.0	42.9	25.0	52.4	10.8	50.9	20.2	49.5
1.0	44.4	3.1	53.2	7.8	55.4	11.5	67.4	7.7	47.3
-3.4	43.0	26.2	50.7	1.3	50.5	21.0	61.5	18.0	41.7
12.1	64.1	9.0	21.9	7.7	48.4	10.5	71.0	8.5	70.8
43.8	84.3	8.1	54.0	8.7	40.6	-0.0	56.1	29.0	42.7
30.2	56.3	25.3	43.6	24.6	47.6	24.9	64.7	13.1	52.4
35.9	56.3	12.2	56.2	21.5	33.5	17.0	30.2	17.6	48.7
27.9	54.4	22.3	41.7	14.6	62.0	0.9	38.8	26.0	45.5
25.4	64.6	16.9	58.8	16.7	46.1	30.6	74.5	3.5	67.9
-0.7	33.8	13.3	30.6	19.7	43.9	18.1	32.6	-5.9	49.1
2.7	35.1	12.5	39.0	12.3	43.3	27.9	40.4	9.6	23.1
4.9	59.3	15.0	40.4	3.9	60.5	11.6	62.2	25.3	79.6
-0.5	53.5	1.2	74.1	0.4	10.7	-7.0	36.2	12.1	69.7
30.0	46.8	1.5	55.7	44.2	63.8	32.2	49.7	10.9	78.8
7.2	73.4	13.1	56.6	27.8	58.3	29.3	66.8	36.4	65.4
15.9	42.0	2.0	21.7	-8.9	35.1	21.9	76.9	9.9	46.4
8.9	57.9	41.2	54.2	4.9	34.1	20.7	50.3	19.0	48.8
6.8	56.9	33.8	47.5	-0.0	31.5	13.2	28.6	16.4	67.2
38.0	59.1	0.5	54.7	22.6	58.5	3.3	30.8	0.0	26.0
11.2	33.4	3.2	30.3	9.9	42.2	18.3	35.5	4.8	53.3
14.6	29.2	15.4	44.6	2.9	22.0	11.0	35.8	-0.1	29.2
13.7	31.5	19.4	38.0	21.9	58.7	25.6	40.2	23.5	54.9
33.1	49.4	8.3	72.8	6.3	19.9	-2.3	48.8	26.2	52.1
36.5	75.1	23.6	55.8	44.4	55.6	34.1	59.3	20.2	41.3
17.9	34.3	-13.4	53.1	-1.0	40.3	19.7	39.6	17.7	57.9
43.4	56.4	18.3	46.7	26.9	45.0	26.3	43.6	21.1	34.7
3.7	47.8	4.0	30.3	-7.7	52.5	9.1	25.4	10.9	42.0
-13.9	48.9	31.4	46.1	29.5	49.2	36.5	54.3	30.7	45.3
3.5	33.9	7.5	68.0	17.1	52.7	29.8	42.1	9.3	81.6
31.0	55.4	41.1	52.0	14.4	51.7	22.0	55.4	25.9	48.1
9.3	60.2	32.1	74.5	15.2	66.6	11.2	53.4	7.2	29.4
0.4	40.5	29.2	41.7	10.0	41.9	16.8	65.8	36.7	59.8
18.0	68.2	32.3	53.5	36.0	55.7	42.1	55.9	-1.5	63.2
13.2	57.8	41.7	51.9	4.7	48.0	35.7	47.2	12.2	32.6
15.1	62.0	19.2	51.8	25.2	61.0	4.0	33.1	20.7	41.8
10.3	39.2	14.5	62.2	7.9	39.1	22.7	45.0	6.7	54.8
32.4	55.9	20.0	54.9	18.5	45.3	9.0	60.5	10.8	38.2
20.8	34.2	21.4	56.4	7.6	71.0	19.5	59.1	37.5	48.7
17.7	85.4	19.2	60.8	18.4	48.5	19.0	47.4	20.2	46.1
22.7	59.3	41.5	75.9	20.3	37.2	12.2	37.7	20.4	43.0
20.7	34.8	3.9	31.0	19.4	35.1	15.5	44.9	27.0	76.2
33.6	48.5	24.0	37.3	13.8	28.3	7.7	22.8	12.4	56.6
19.2	63.7	36.3	58.5	-0.3	37.0	16.0	56.8	11.5	24.3
7.5	52.1	15.0	41.9	9.5	45.8	25.2	42.7	18.3	64.1
7.5	33.5	15.6	43.2	29.1	52.3	29.1	44.3	25.8	59.6
37.4	48.5	31.8	62.1	25.8	59.6	28.5	53.5	19.4	35.3
18.8	40.3	15.0	42.2	19.5	45.1	33.9	63.7	25.0	52.6
25.4	63.3	10.4	70.6	18.6	81.5	7.9	80.3	19.2	77.9
-3.7	71.1	-0.4	54.6	40.3	77.9	21.2	50.3	24.8	59.1
-0.5	73.3	9.5	69.8	23.1	34.6	24.2	56.6	5.2	40.5
22.3	54.1	14.3	59.4	11.9	42.1	18.8	56.0	30.0	49.2
39.1	52.7	6.6	40.2	16.2	45.4	21.1	46.5	14.9	43.8
-0.4	37.6	11.4	45.1	33.5	53.3	6.4	49.0	37.0	54.1
8.5	34.0	12.7	71.1	22.0	37.2	6.8	36.0	19.3	49.3
9.8	54.0	32.9	49.5	29.3	55.2	-3.5	59.8	-0.8	47.6
7.3	51.2	0.9	43.9	20.5	37.8	7.9	43.6	-4.1	35.8
3.9	47.1	23.0	48.9	32.5	54.1	20.0	40.3	17.5	67.3
6.3	33.6	4.3	21.1	10.2	30.0	17.5	30.9	18.2	35.1
-1.6	48.1	5.1	62.0	25.7	52.7	-0.5	43.0	-4.9	50.7
2.2	39.0	21.6	49.0	15.4	51.6	17.3	46.4	19.0	95.3
44.6	58.8	30.4	62.1	21.5	61.9	48.6	80.0	10.6	36.3
13.0	53.5	18.1	70.4	47.6	61.1	10.2	32.7	5.7	21.1
7.6	22.2	7.8	50.4	18.3	40.4	14.7	44.1	22.7	52.5
6.0	69.8	12.2	38.1	6.4	60.1	31.1	43.5	-3.7	30.5
16.2	27.8	5.5	57.6	-0.4	23.5	10.4	49.9	14.6	33.9
23.2	69.0	18.4	75.3	18.7	51.7	14.2	47.2	2.8	25.6
-3.1	29.0	5.0	15.7	2.6	44.9	-2.1	69.8	30.0	43.1

2.4	53.9	37.3	56.0	14.9	35.0	15.0	31.2	14.8	38.5
17.4	30.2	14.5	46.8	11.4	61.8	13.2	88.6	11.2	49.2
25.1	52.7	0.9	46.2	24.0	37.3	3.0	47.6	28.4	66.5
8.0	55.2	18.9	46.7	22.7	52.5	0.3	48.4	15.9	61.7
17.2	57.0	5.1	44.0	-4.6	52.7	-2.8	41.7	-5.9	43.7
-15.2	41.5	12.0	65.3	14.2	54.2	26.9	63.1	5.1	40.8
2.8	57.0	39.2	49.2	6.6	41.3	21.4	58.6	6.7	28.7
13.9	48.5	8.3	36.5	12.0	25.2	-0.4	54.8	17.6	32.2
1.5	15.1	2.1	21.9	9.6	48.4	11.0	29.0	8.2	71.7
14.6	45.3	12.5	34.7	11.6	41.9	12.9	35.6	17.5	54.6
12.1	29.6	15.5	38.1	1.5	36.2	23.4	51.8	4.0	47.5
11.1	31.8	7.6	44.0	12.0	50.2	12.1	30.1	14.4	68.5
12.7	31.3	13.3	54.9	34.9	59.0	11.1	28.2	9.4	34.8
15.5	47.3	10.3	54.4	12.4	59.0	27.8	67.2	-10.2	26.8
8.0	57.4	-8.0	49.0	-9.1	47.1	28.1	68.0	4.0	58.4
18.2	51.6	30.1	51.1	9.2	75.7	19.0	56.7	5.9	29.8
19.3	59.5	32.1	60.1	15.7	61.8	3.1	35.5	20.5	31.9
21.0	53.9	23.8	45.7	15.6	41.8	23.3	51.3	-0.7	38.0
19.3	49.0	8.0	66.6	39.7	71.5	35.3	58.7	16.6	42.3
2.4	41.7	18.2	61.0	16.8	29.7	5.2	50.6	3.4	52.0
19.1	40.9	3.6	51.7	23.8	64.5	52.9	87.5	15.3	64.9
29.2	62.5	30.9	42.6	13.1	35.1	7.8	42.1	-0.5	41.6
-0.7	14.1	-0.3	65.3	13.0	46.2	16.4	46.3	-0.1	58.9
24.7	37.0	12.2	64.5	27.7	43.1	22.3	55.4	10.6	35.2
14.4	50.6	23.1	52.7	11.2	42.8	15.0	45.8	3.9	39.4
14.4	47.5	-3.4	17.2	0.4	42.8	31.1	41.2	16.4	68.5
19.2	57.1	40.6	58.5	-6.1	13.6	-11.5	58.2	28.3	55.9
19.9	33.4	3.9	44.3	9.1	45.6	31.5	57.5	44.9	60.0
-1.3	69.5	-3.5	27.3	15.4	39.7	22.0	41.2	-0.8	52.1
14.6	67.4	7.2	57.7	22.2	58.8	23.9	45.0	13.7	44.7
22.4	37.3	8.8	48.4	11.9	22.2	9.5	50.9	27.0	38.4
3.5	62.5	10.9	55.8	14.5	50.0	35.9	62.8	29.9	53.6
16.7	59.5	21.7	43.0	31.8	43.6	4.1	32.2	2.6	59.1
15.2	56.4	8.7	49.9	25.4	46.7	7.3	62.9	41.6	55.7
40.0	52.0	7.8	33.1	19.8	42.6	26.3	43.8	1.4	57.1
1.7	49.5	32.4	53.9	39.4	67.5	26.6	39.7	18.9	44.3
20.5	36.8	9.8	58.5	16.5	60.9	24.8	48.3	27.5	51.1
-3.2	41.4	25.7	70.7	37.9	59.4	25.1	48.1	23.5	50.2
24.4	74.0	25.9	57.8	26.3	73.9	60.2	72.8	24.3	40.9
16.4	50.2	-0.5	29.9	14.1	38.5	26.1	38.2	3.1	36.6
7.8	30.5	14.6	45.1	28.6	49.6	21.7	58.3		

APPENDIX C

INPUT DATA FOR STUDY SPECTRA

The input data used in generating the spectra analyzed in the study summarized in Reference 2 are presented in this section. Fifteen different input data sets were used with this program. The titles associated with the data sets are not part of the input data.

```
AIR-TO-AIR BASELINE
   15      2      7     46    759
 0.            4904.         .0022       3903.       .0044       2561.
 .0067         2240.         .0089       2138.       .0111       1817.
 .0133         1977.         .0156       3126.       .0178       3794.
 .02           3088.         .0222       2093.       .0244       1316.
 .0267         995.          .0289       1303.       .0311       1406.
 .0333         1027.         .0356       802.        .0378       757.
 .04           629.          .0422       443.        .0444       334.
 .0467         379.          .0489       488.        .0511       417.
 .0533         315.          .0556       308.        .0578       276.
 .06           244.          .0622       205.        .0644       154.
 .0667         160.          .0689       160.        .0711       160.
 .0733         160.          .0756       141.        .0778       128.
 .08           116.          .0822       109.        .0844       83.
 .0867         49.           .0889       51.         .0911       60.
 .0933         57.           .0956       47.         .0978       40.
 .1            45.
   12    5.          10.0        10.0        22.2        1.128       1
   13   10.
  800
 9873
 7829
 3649
 4556
 6969
49601
```

```
AIR-TO-GROUND BASELINE
    15      2      7   101    759
0.        241.      .0008     266.      .0016     221.
.0024     143.      .0032     121.      .004      117.
.0048     117.      .0056     113.      .0064     169.
.0072     213.      .008      194.      .0088     219.
.0096     315.      .0104     396.      .0112     365.
.012      251.      .0128     204.      .0136     206.
.0144     181.      .0152     189.      .016      219.
.0168     214.      .0176     201.      .0184     201.
.0192     202.      .02       222.      .0208     256.
.0216     241.      .0224     184.      .0232     160.
.024      149.      .0248     124.      .0256     120.
.0264     131.      .0272     133.      .028      132.
.0288     117.      .0296     89.       .0304     81.
.0312     85.       .032      98.       .0328     119.
.0336     106.      .0344     83.       .0352     80.
.036      87.       .0368     102.      .0376     102.
.0384     75.       .0392     55.       .04       56.
.0408     65.       .0416     73.       .0424     84.
.0432     87.       .0440     68.       .0448     61.
.0456     70.       .0464     66.       .0472     52.
.048      48.       .0488     49.       .0496     51.
.0504     47.       .0512     43.       .052      48.
.0528     52.       .0536     47.       .0544     36.
.0552     28.       .0560     33.       .0568     34.
.0576     25.       .0584     26.       .0592     34.
.06       33.       .0608     24.       .0616     21.
.0624     21.       .0632     18.       .064      19.
.0648     25.       .0656     29.       .0664     25.
.0672     23.       .068      27.       .0688     30.
.0696     25.       .0704     17.       .0712     16.
.072      18.       .0728     17.       .0736     14.
.0744     13.       .0752     15.       .076      14.
.0768     13.       .0776     16.       .0784     15.
.0792     11.       .08       11.
    15    1.       10.0      10.0       6.5       1.6     0
    13   10.
   936
  2649
  3619
  4271
  5863
  6987

INSTRUMENTATION AND NAVIGATION BASELINE
    15      2      7   101   2485
0.        72.8      .0008     80.4      .0016     66.8
.0024     43.2      .0032     36.5      .004      35.5
.0048     35.4      .0056     34.2      .0064     51.2
.0072     64.4      .008      58.8      .0088     66.4
.0096     95.2      .0104     120.      .0112     110.
.012      76.       .0128     61.6      .0136     62.4
.0144     54.8      .0152     57.2      .016      66.4
.0168     64.8      .0176     60.8      .0184     60.8
.0192     61.2      .02       67.2      .0208     77.6
.0216     72.8      .0224     55.6      .0232     48.4
.024      45.2      .0248     37.4      .0256     36.3
.0264     39.5      .0272     40.4      .028      40.
.0288     35.5      .0296     26.9      .0304     24.4
.0312     25.7      .032      29.6      .0328     35.9
.0336     32.1      .0344     25.       .0352     24.1
.036      26.2      .0368     30.8      .0376     31.
.0384     22.8      .0392     16.8      .04       16.9
.0408     19.7      .0416     22.1      .0424     25.4
.0432     26.2      .044      20.7      .0448     18.5
.0456     21.2      .0464     19.9      .0472     15.8
.048      14.6      .0488     14.8      .0496     15.3
.0504     14.4      .0512     13.       .052      14.6
.0528     15.7      .0536     14.2      .0544     10.9
.0552     8.5       .056      10.       .0568     10.2
.0576     7.7       .0584     7.7       .0592     10.1
.06       9.9       .0608     7.2       .0616     6.2
.0624     6.2       .0632     5.5       .064      5.6
.0648     7.7       .0656     8.8       .0664     7.5
.0672     7.        .068      8.3       .0688     9.
.0696     7.5       .0704     5.1       .0712     4.8
.072      5.6       .0728     5.        .0736     4.1
.0744     4.1       .0752     4.7       .076      4.4
.0768     4.1       .0776     4.9       .0784     4.6
.0792     3.4       .08       3.3
    10    1        10.0      10.0       6.0       1.75    1
    12   10.
```

```
EXCEEDANCE CURVE VARIATION NO. 1
     15        2     7     46   759
0.             2300.       .0022         1830.        .0044         1200.
.0067          1050.       .0089         1000.        .0111         850.
.0133          925.        .0156         1460.        .0178         1780.
.02            1450.       .0222         980.         .0244         616.
.0267          466.        .0289         610.         .0311         658.
.0333          481.        .0356         375.         .0378         354.
.04            294.        .0422         207.         .0444         156.
.0467          177.        .0489         228.         .0511         195.
.0533          147.        .0556         144.         .0578         129.
.06            114.        .0622         95.9         .0644         72.1
.0667          74.9        .0689         74.9         .0711         74.9
.0733          74.9        .0756         66.          .0778         59.9
.08            54.3        .0822         51.          .0844         38.8
.0867          22.9        .0889         23.9         .0911         28.1
.0933          26.7        .0956         22.          .0978         18.7
.1             21.1
     12     5.          10.0         10.0         22.2        1.128     1
     16    10.
    800
   9873
   7829
   3649
   4556
   6969
  49601
   2017
   3493
   4217
   5184
EXCEEDANCE CURVE VARIATION NO. 2
     15        2     7     46   759
0.             3060.       .0022         2430.        .0044         1600.
.0067          1400.       .0089         1330.        .0111         1130.
.0133          1230.       .0156         1940.        .0178         2370.
.02            1930.       .0222         1300.        .0244         819.
.0267          620.        .0289         811.         .0311         875.
.0333          640.        .0356         499.         .0378         471.
.04            391.        .0422         275.         .0444         207.
.0467          235.        .0489         303.         .0511         259.
.0533          196.        .0556         192.         .0578         172.
.06            152.        .0622         128.         .0644         95.9
.0667          99.6        .0689         99.6         .0711         99.6
.0733          99.6        .0756         87.8         .0778         79.7
.08            72.2        .0822         67.8         .0844         51.6
.0867          30.5        .0889         31.8         .0911         37.4
.0933          35.5        .0956         29.3         .0978         24.9
.1             28.1
     12     5.          10.0         10.0         22.2        1.128     1
     16    10.
    800
   9873
   7829
   3649
   4556
   6969
  49601
   2017
   3493
```

```
EXCEEDANCE CURVE VARIATION NO. 3
   15      2     7     46   759
0.           3930.         .0022          3120.          .0044          2050.
.0067        1800.         .0089          1710.          .0111          1450.
.0133        1580.         .0156          2490.          .0178          3040.
.02          2480.         .0222          1670.          .0244          1050.
.0267        796.          .0289          1040.          .0311          1120.
.0333        822.          .0356          641.           .0378          605.
.04          502.          .0422          353.           .0444          266.
.0467        302.          .0489          389.           .0511          333.
.0533        252.          .0556          247.           .0578          221.
.06          195.          .0622          164.           .0644          123.
.0667        128.          .0689          128.           .0711          128.
.0733        128.          .0756          113.           .0778          102.
.08          92.7          .0822          87.1           .0844          66.3
.0867        39.2          .0889          40.8           .0911          48.
.0933        45.6          .0956          37.6           .0978          32.
.1           36.1
   12    5.          10.0          10.0          22.2          1.128      1
   16   10.
  800
 9873
 7829
 3649
 4556
 6969
49601
```

```
EXCEEDANCE CURVE VARIATION NO. 4
   15      2     7     46   759
0.           6000.         .0022          4760.          .0044          3130.
.0067        2750.         .0089          2610.          .0111          2210.
.0133        2410.         .0156          3800.          .0178          4640.
.02          3780.         .0222          2550.          .0244          1600.
.0267        1210.         .0289          1590.          .0311          1710.
.0333        1250.         .0356          978.           .0378          923.
.04          766.          .0422          539.           .0444          406.
.0467        461.          .0489          594.           .0511          508.
.0533        385.          .0556          377.           .0578          337.
.06          298.          .0622          250.           .0644          188.
.0667        195.          .0689          195.           .0711          195.
.0733        195.          .0756          172.           .0778          156.
.08          141.          .0822          133.           .0844          101.
.0867        59.8          .0889          62.3           .0911          73.2
.0933        69.6          .0956          57.4           .0978          48.8
.1           55.1
   12    5.          10.0          10.0          22.2          1.128      1
   16   10.
  800
 9873
 7829
 3649
 4556
 6969
49601
```

```
EXCEEDANCE CURVE VARIATION NO. 5
      15        2     7     46    759
0.          7200.       .0022        5710.        .0044        3760.
.0067       3300.       .0089        3130.        .0111        2650.
.0133       2890.       .0156        4560.        .0178        5570.
.02         4540.       .0222        3060.        .0244        1920.
.0267       1450.       .0289        1910.        .0311        2050.
.0333       1500.       .0356        1170.        .0378        1110.
.04         919.        .0422        647.         .0444        487.
.0467       553.        .0489        713.         .0511        610.
.0533       462.        .0556        452.         .0578        404.
.06         358.        .0622        300.         .0644        226.
.0667       234.        .0689        234.         .0711        234.
.0733       234.        .0756        206.         .0778        187.
.08         169.        .0822        160.         .0844        121.
.0867       71.8        .0889        74.8         .0911        87.8
.0933       83.5        .0956        68.9         .0978        58.6
.1          66.1
      12    5.        10.0        10.0        22.2        1.128      1
      16   10.
     800
    9873
    7829
    3649
    4556
    6969
   49601
EXCEEDANCE CURVE VARIATION NO.6
      15        2     7     46    759
0.          8500.       .0022        6740.        .0044        4440.
.0067       3890.       .0089        3690.        .0111        3130.
.0133       3410.       .0156        5380.        .0178        6570.
.02         5360.       .0222        3610.        .0244        2270.
.0267       1710.       .0289        2250.        .0311        2420.
.0333       1770.       .0356        1380.        .0378        1310.
.04         1080.       .0422        763.         .0444        575.
.0467       653.        .0489        841.         .0511        720.
.0533       545.        .0556        533.         .0578        477.
.06         422.        .0622        354.         .0644        267.
.0667       276.        .0689        276.         .0711        276.
.0733       276.        .0756        243.         .0778        221.
.08         199.        .0822        189.         .0844        143.
.0867       84.7        .0889        88.3         .0911        104.
.0933       98.5        .0956        81.3         .0978        69.1
.1          78.
      12    5.        10.0        10.0        22.2        1.128      1
      16   10.
     800
    9873
    7829
    3649
    4556
    6969
```

```
COUPLING PEAKS AND VALLEYS NO. 1
    15      2      7       6 4598
0.          2093.       .035         2093.        .0351        262.
.1          262.        .1001        0.           .1228        0.
    12    5.        10.0        10.0         22.2        1.128        1
    16   10.
  1234
  5876
  5934
  1747
  6985
  5445
  7656
  9874

COUPLING PEAKS AND VALLEYS NO. 2
    15      2      7       6 6585
0.          226.        .0192        226.         .0193        56.5
.08         56.5        .0801        0.           .0979        0.
    15    1.        10.0        10.0          6.5        1.6          0
    13   10.
  3258
   475
  5811
  1357
  9753
  2244
  8357

COUPLING PEAKS AND VALLEYS NO. 3
    15      2      7       4  759
0.          902.5       .1           902.5        .1001        0.
.1407       0.
    12    5.        10.0        10.0         22.2        1.128        1
    16   10.
  3649
  4556
  6823
  1593
  9873

COUPLING PEAKS AND VALLEYS NO. 4
    15      2      7       4  123
0.          97.25       .08          97.25        .0801        0.
.1002       0.
    15    1.        10.0        10.0          6.5        1.6          0
    13   10.
  5803
  4444
   759
  5858
  6556

COUPLING PEAKS AND VALLEYS NO. 5
    15      0      7       6 9873
0.          0.          .0125        0.           .0126        18418.
.0174       18418.      .0175        0.           .1136        0.
    12    5.        10.0        10.0         22.2        1.128        1
    16   10.
  7829
  3649
  4587
  4854
   800

COUPLING PEAKS AND VALLEY NO. 6
    15      0      7       6 8745
0.          0.          .01          0.           .0101        1588.
.0149       1588.       .015         0.           .0836        0.
    15    1.        10.0        10.0          6.5        1.6          0
    13   10.
  8520
  6574
  4696
  2000
   169
```

APPENDIX D

LIST OF COMPUTER PROGRAM SYMBOLS AND DEFINITIONS

A(K)	Coefficient defined by Equations (3) and (4); also, as output by HARM subroutine the coefficient is a value of the Gaussian time history
A1	First peak or valley in Gaussian time history
A2	Time of first peak or valley in Gaussian time history
ADZ	Value of the increment used in output of simulated real time peak and valley exceedance tables
ANDZ	Number of increments used in output of simulated real time peak and valley exceedance tables
B	Random phase angle $0 \leq B \leq 2\pi$
C1,C2,C3	Coefficients in the equation $x = C1 + C2\ t + C3\ t^2$, used to search for a peak or valley value
DNZ	Upper value of a range used in output of peak and valley exceedance tables
DNZ1	Lower value of a range used in output of peak and valley exceedance tables
DW	Frequency interval of the power spectral density analysis
DZ	Value of the increment to be used in output of peak and valley exceedance tables
FMØN	Fourth moment of the power spectral density graph about the PSD axis
FO	Theoretical number of mean level crossings per unit time
FP	Theoretical number of peaks per unit time
I1	Subscript of the range of a peak being tabulated in the exceedance tables
I2	Subscript of the range of a valley being tabulated in the exceedance tables
IA1	Number of points in the Gaussian time history, N, plus 1
IFERR	HARM subroutine error indicator
IFIN	An identifier indicating whether the A(K) matrix is Gaussian, unfiltered simulated real, or filtered simulated real
IFSET	HARM subroutine control, IFSET = 1 sets up sine and inverse tables and calculates Fourier transform
IN	Identifies computer unit used for input

APPENDIX D

LIST OF COMPUTER PROGRAM SYMBOLS AND DEFINITIONS

A(K)	Coefficient defined by Equations (3) and (4); also, as output by HARM subroutine the coefficient is a value of the Gaussian time history
A1	First peak or valley in Gaussian time history
A2	Time of first peak or valley in Gaussian time history
ADZ	Value of the increment used in output of simulated real time peak and valley exceedance tables
ANDZ	Number of increments used in output of simulated real time peak and valley exceedance tables
B	Random phase angle $0 \leq B \leq 2\pi$
C1,C2,C3	Coefficients in the equation $x = C1 + C2\ t + C3\ t^2$, used to search for a peak or valley value
DNZ	Upper value of a range used in output of peak and valley exceedance tables
DNZ1	Lower value of a range used in output of peak and valley exceedance tables
DW	Frequency interval of the power spectral density analysis
DZ	Value of the increment to be used in output of peak and valley exceedance tables
FMØN	Fourth moment of the power spectral density graph about the PSD axis
FO	Theoretical number of mean level crossings per unit time
FP	Theoretical number of peaks per unit time
I1	Subscript of the range of a peak being tabulated in the exceedance tables
I2	Subscript of the range of a valley being tabulated in the exceedance tables
IA1	Number of points in the Gaussian time history, N, plus 1
IFERR	HARM subroutine error indicator
IFIN	An identifier indicating whether the A(K) matrix is Gaussian, unfiltered simulated real, or filtered simulated real
IFSET	HARM subroutine control, IFSET = 1 sets up sine and inverse tables and calculates Fourier transform
IN	Identifies computer unit used for input

INC	Indicator used to control adjustment of simulated real time history
IØ	Identifies computer unit used for output
IX	Random number $0 \geq IX \geq 1048576$
IZ	Subscript of the range of a peak or valley being tabulated in the occurrence tables
K	Subscript of the A(K) terms, see A(K)
KKK	The number of Gaussian, or unfiltered simulated real peaks and valleys, times 2
KP	The subscript of the current peak being evaluated in the FILTER subroutine
KV	The subscript of the current valley being evaluated in the FILTER subroutine
K1	An integer used to control the computation of the A(K) terms in MAIN; also, the quantity $\sqrt{1-R1^2}$ in EXCED subroutine
K2	The quantity K1/R in EXCED subroutine
M	Three term array input to HARM subroutine; M(1)=M1, M(2)=M(3)=0
M1	$N = 2^{M1}$, See N
MEAN	Mean value used in mapping Gaussian to simulated real time history
N	Number of points to be computed in the random time history
N1	In formulating the A(K) terms, the number of times the PSD is assumed constant within each frequency range, DW
N2	The quantity 2 x N
NDZ	Number of increments to be used in output of Gaussian peak and valley
NDZ1	The integer NDZ+1
NIX	Quotient of division performed in random number generation
NMAX	The integer N - 1
NM1	The integer 2N - 1
NP	The subscript of the next peak being evaluated in the FILTER subroutine
NOPTS	The number of points in the linear interpolation table used in subroutine TLU
NPKR	Total number of peaks and valleys times 2
NPEAKS	Number of peaks or valleys within a range in the occurrence and exceedance tables

NR	Factor by which the PSD frequency axis is extended to increase the sensitivity of the output
NSL	Indicator describing whether a time history data point is a peak, neither a peak or valley, or a valley
NSPD	Number of input data points on the PSD vs frequency graph
NX	Number of divisions of the PSD graph used in analysis
PL	Theoretical exceedance value
PMAX,PMIN	In order for a peak and valley to be counted and included in the output list, the maximum rise or fall must exceed the input value of PMAX, and the minimum rise or fall must exceed the input value of PMIN
PR	Current value of filter criterion, PMAX or PMIN in subroutine FILTER
P1	Probability of not exceeding X1, normal probability distribution
P2	Probability of not exceeding X2, normal probability distribution
PSD	Value of power spectral density
R	Transformation exponent used in mapping Gaussian to simulated real time history
R1	Rate of FO to FP
S	Value of PSD
S2	Product $\sqrt{2\Delta\omega}\ \sqrt{S_K}$, see Equations (3) and (4)
SL1	Difference in value of two consecutive Gaussian time history points, i, i + 1
SL2	Difference in value of next two consecutive, i + 1, i + 2, see SL1
SMØN	Second moment of the power spectral density graph about the PSD axis
TIME	Total time represented by Gaussian time history
VAR	Area of the power spectral density graph
W	Frequency for an input value of power spectra density
WI	Frequency for a value of power spectral density
X	Independent variable in a two-dimensional table
XN	Normalized lower value of a range used in output of peak and valley exceedance tables
XM	Time of a Gaussian peak or valley

X1	The quantity XN/K1
X2	The quantity XN/K2
XVAL	Independent variable to be used in interpolation in a two-dimensional table
Y	Dependent variable in a two-dimensional table
YM	Value of a Gaussian peak or valley
YVAL	Dependent variable determined by interpolation of a two dimensional table

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